

T H E E L E C T R O N

NEWSLETTER OF THE INSTITUTION OF ELECTRONICS

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WELCOME TO THE ELECTRON AUTUMN 2020

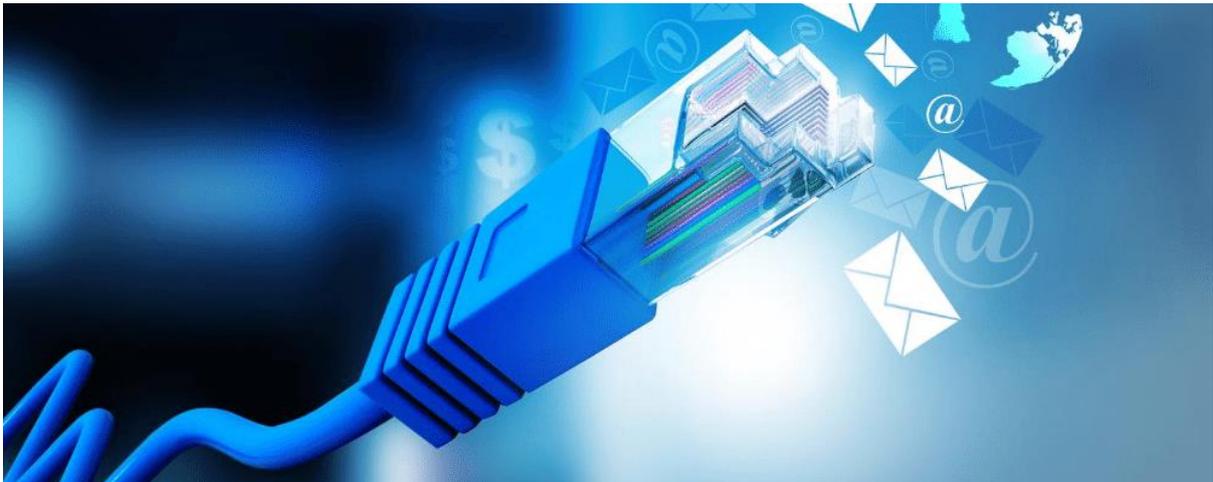
The Institution of Electronics is pleased to welcome all of its members and readers to the autumn 2020 issue of The Electron.

With exhibitions and conferences continuing to be cancelled, postponed or moved online The Institution continues to thank its online contributors for their submissions.

In this regard The Institution would particularly like to thank Nicole Cappella and James Orme of Technerati, the news team of Data Centre Review, What's New in Electronics, i4.0 Today, SMT Today, Med-Tech Innovation and electronics product specialist Softei.

The following represents an 'Editor's Selection' of the various submissions received from the period from June 30th. to September 30th.

UNIVERSITY COLLEGE LONDON SETS NEW RECORD FOR INTERNET SPEED



Researchers at University College London have set a new record for internet speed which is twice the data transmission speed of any system currently in use anywhere in the world.

In a project in collaboration with Xtera and KDDI Research, a data transmission rate of 178 TB/second was achieved, which "could download the entire Netflix library in less than a second".

In order to accomplish the breakthrough the bandwidth of typical optical fibre was increased by using a wider spectrum of wavelengths, which enabled a transmission rate of 16.8 THz, almost double the commercial bandwidth standard of 9 THz. Amplifier technologies were then combined to allow the signal to be spread across the wider bandwidth, and the properties of each individual wavelength were manipulated to maximise the usefulness of phase, brightness and polarisation of each.

A major benefit of the breakthrough is noted to be the fact that it can be replicated outside the laboratory cost-effectively on existing infrastructure by upgrading the amplifiers that already exist on optical fibre routes. The result is that data transmission can be significantly improved at a fraction of the cost of laying new fibre or installing new equipment.

The increase in transmission speed from 35 TB/second on a standard data centre to 178 TB/second is envisaged to "significantly improve the capability of broadband networks".

The previous record of 159 TB/second was set in 2018 by Japanese researchers who used a combination of multi-mode fibre and upgraded modulation technology.

In 2019 m-Net and Nokia achieved a data transmission rate of 50 GB/second over a single wavelength in a 5G test, which they believed could result in a short-range capacity of 76.8 TB/second.

[Contribution by Nicole Cappella].

NASA USES DEEP LEARNING TO PREDICT SOLAR FLARES

Researchers at NASA have developed new deep learning techniques powered by Nvidia GPUs that can identify activity beneath the surface of the Sun and predict potentially dangerous solar flares.

The development enables measurement of plasma flow in the Sun's atmosphere which can then be used to predict events such as solar flares, which can cause damage to power grids and satellite communication systems, as well as threatening the lives of astronauts.

Advanced imaging systems have been developed to track the movement of the Sun's granular surface using GPU computing with Nvidia Quadro RTX-powered HP Z8 workstations.

NASA scientists created custom artificial intelligence (AI) algorithms with a deep learning neural network which observes granules using images from the Solar Dynamics Observatory

and then learns how to reconstruct their motions. Nvidia GPUs were deployed to train the neural networks as ordinary CPU power was insufficient to handle the number of iterations or the amount of preprocessing required to develop robust deep learning models.

Prior to switching from a 72 CPU-core compute node to a Nvidia Quadro RTX 8000 GPU it took an hour to complete one pass with the training data. One training round now takes around three minutes.

Raphael Attie, Solar Astronomer at the NASA Goddard Space Flight Centre states:

"This incredible speedup enables us to try out different ways to train the models and make 'stress tests', like preprocessing images at different resolutions or introducing synthetic errors to better emulate imperfections in the telescopes. That kind of accelerated workflow completely changed the scope of what we can afford to explore".

[Contributed by James Orme].

QUANTUM BREAKTHROUGH IMPROVES INTERNET SECURITY

A major breakthrough in internet security has been made by a team of scientists at Bristol University that is said to have brought the world one step closer to achieving a "totally secure" internet.

A prototype has been designed which uses a quantum technique incorporating 'entanglement' that exploits the power of two particles in separate locations, potentially thousands of miles apart, to simultaneously mimic each other.

The resulting system makes messages completely safe from interception, whilst also overcoming major challenges that have previously limited advances in the field of quantum technology.

The internet relies on complex codes to protect information and quantum computing has often been considered as a revolutionary alternative to standard encryption techniques. Physicists have already developed a form of encryption known as quantum key distribution whereby particles of light in the form of photons are transmitted allowing two parties to share, without risk of interception, a secret key used to encrypt and decrypt information, but this has only been effective between two users.

The Bristol team created a network for eight users using eight receiver boxes. The existing system would have required the number of users multiplied many times, in this case 56 boxes, and as user numbers increase so the logistics increasingly lack viability. For example, 100 users would require 9,900 receiver boxes.

The prototype was created in months at a cost of under £300,000, where previous quantum systems would have taken years to build and cost millions or even billions of pounds.

Lead Author Siddworth Joshi states:

"This represents a massive breakthrough and makes the quantum internet a much more realistic proposition. Until now, building a quantum network has entailed huge cost, time and resource, as well as compromising on its security, which defeats the whole purpose.

Until now, efforts to expand the network have involved vast infrastructure and a system which requires the creation of another transmitter and receiver for every additional user. Sharing messages in this way, known as trusted nodes, is not good enough because it uses so much extra hardware which could leak and would no longer be totally secure.

Our solution is scalable, relatively cheap and, most important of all impregnable. That means it's an exciting game-changer and paves the way for much more rapid development and widespread rollout of this technology".

[Reference: 'A trusted Node-free Eight-user Metropolitan Quantum Communication Network', *Journal of Science Advances*].

CYBER-ATTACKS DOUBLE ON CONNECTED CARS



So-called 'connected cars' offer many convenient functions such as remote locking and smart phone linking, but in 2019 the number of reported cyber-attacks on them increased by 99 per cent on the previous year. With 67 per cent of new UK cars now 'connected', this means that over two thirds of Britain's newest cars are vulnerable to personal data fraud.

The problem stems from the fact that a standard 'connected car' uses 150 million lines of code (103.5 million more than a Boeing 787 aircraft) and criminals only need to change a few lines of code in order to steal personal data.

Methods of Theft

1. Keyless Car Theft

A person stands by the car with a transmitter whilst a second stands at the property with a device that picks up a signal from the key. The signal is relayed to the transmitter and the car is unlocked by a fake signal. The time taken is less than ten seconds and 92 per cent of cars recovered from theft in 2019 were stolen without the keys.

2. Weakness in connected Mobile Apps

Apps that communicate with cars are released continuously and if the app has vulnerabilities hackers can effectively gain 'authorised' access to personal data. An example occurred with Nissan where an app that failed security testing enabled hackers to begin controlling features such as heated seating, fans and air conditioning.

3. Seizing Remote Control of Vehicles

In this case hackers seize control of safety-critical features such as braking, steering and ignition by hacking into the vehicle's internal networks. With this method a Jeep was hacked into and interfered with as it was being driven down a busy road and, for example, the brakes were slammed remotely.

4. Personal Data Theft

The built-in apps of a 'connected car' tracks personal data such as location, entertainment preference and, worryingly, financial information. Hackers can steal this data by remote access through text message scams, spyware and signal interception.

Jonaton O'Mara, a cyber-security expert from CompareMyVPN, states:

"Even if basic privacy measures were put in place, we feel anonymised data can be easily matched with other elements to break down any attempts to promote user privacy.

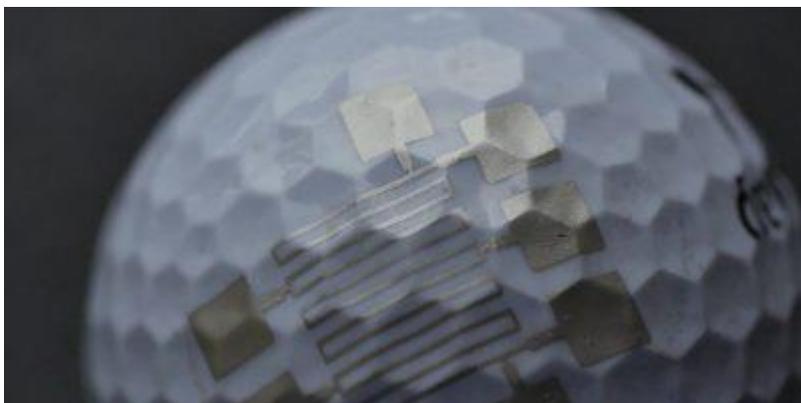
In addition the car companies themselves can now collect huge swathes of rich personal data - mainly location-based and habitual movements.

However, this also covers connected device activity such as calls made, messages and phone numbers.

What we need is pressure from regulators and the cyber-security industry to ensure that connected car data is both encrypted end-to-end to reduce any threat from a third party as well as what data is actually stored and kept".

[Contribution by *Data Centre Review*]

NEW DIRECT PRINTING TECHNIQUE ALLOWS APPLICATION OF FUNCTIONAL ELECTRONIC LAYERS DIRECTLY ON A COMPONENT



A new direct printing technique, known as the Binder Method, has been developed by the Binder Innovation and Technology Centre (ITZ) that allows the application of functional electronic layers directly on a component.

What's New in Electronics (August 5th., 2020) explains more:

'With the help of a recently-developed transfer printing technique, Binder was able, for the first time, to apply planar functional electronic layers with a thickness of maximum precision, to textured, three-dimensional surfaces in only one printing pass. In this way, circuit traces, sensors and displays, for example, can be printed. Foils or other substrate materials are completely unnecessary with this technique - an active contribution to environmental protection. The highest demands with regard to environmental conditions and safety can still be met by overprinting a protective layer. Specially developed nano pastes for printing provide stable parameters for the printing process.'

With the synthesis of the knowledge and experience of Binder from the areas of electronics, printing technology, physics and chemistry, the new printing technique has great application potential in any number of industrial areas. The possibilities of printing extend from flexible circuit traces and heating elements up to sophisticated sensors. By printing capacitive sensor elements, for example, touch displays of almost any shape can be implemented on three-dimensional and/or textured surfaces. The same approach can also be used for an intuitive gesture control system. Temperature sensors or strain gauges can be implemented by measuring the change in the resistance values of the printed functional layers. With the flexible printing technique, the entire sensor can be quickly adapted to the application-specific task at hand. As a result, this solution approach is an interesting alternative, also in financial terms, to conventional SMDs'.

INTERTRONICS HELPS NOTTINGHAM TRENT UNIVERSITY DEVELOP FUNCTIONAL TEXTILES



Adhesives specialist Intertronics has supported the Advanced Textiles Research Group at Nottingham Trent University to develop electronic textiles that add functionality to materials and garments.

After Intertronics recommended dispensing Dymax Multi-Cure 9001-E-V3.5 encapsulating resin with the preflow eco-PEN volumetric pump, and curing with a Dymax BlueWave QX4 UV lamp, the team at Nottingham Trent was able to develop a microchip-containing pod 1mm in diameter that could be woven or knitted into textiles.

Recent advances in semiconductor and microelectromechanical systems (MEMS) have reduced both their size and their cost and the Advanced Textiles Research Group has begun incorporating these components into the yarn-making process so as to broaden the possibilities for electronic textiles into areas such as temperature sensing, medical monitoring, motion sensing, energy harvesting and illumination.

By incorporating the components into the yarn fibre, the fabric retains textile properties such as tensile recovery, drapability and breathability.

The market is expected to grow significantly with the size of components diminishing leading to a broadened range of applications.

[Reference: 'Developing Electronic Textiles with UV Curing', *What's New in Electronics*, July 15th., 2020].

ONLINE GAME TRAINS AI COMPONENT OF NEW LEGAL CONTRACT MANAGEMENT SYSTEM

An online game developed in response to the Covid-19 lockdown is now being used to train the artificial intelligence component of a new legal contract management system.

ContrAI is a modular, web-first product that uses AI to aid contract management and analysis. The contract processing required to train the ContrAI system was due to enter its second phase in May following the initial categorisation process at the end of last year, but the lockdown prevented groups of legal students coming together to implement this. The online Clause Game was therefore developed to enable contracts to be marked up remotely, providing essential data to train the algorithm.

Contracts are now being readily processed by law professionals via the game, resulting in a cost-effective and highly scalable solution that has greatly increased the capability for training the AI.

In the game players are shown a series of contract clauses and asked to identify the type of contract to which they relate, as well as stating how confident they are about each answer. They are assessed by the algorithm and awarded a credibility score based on the accuracy of their responses, with an updated leader board announced weekly.

The system learns how credible a player is by assessing their responses and those with a better credibility score make a higher value contribution to the clause categorisation, having greater influence on the algorithm. Essentially the simpler the AI in the game is being used to train the complex AI in the core system.

The ContrAI application has been created by corporate law firm Moorcrofts in partnership with information consultancy CPI Associates following the award of a grant from Innovate UK and Research England in 2019. Using AI, ContrAI reduces the time required for contract review and increases productivity, managing complex contractual arrangements and enabling in-depth analysis of the information held within contracts.

AI and Robotics specialist at Oxford Brookes University, Professor Nigel Crook, states:

"Interesting things happen when AI systems compete with each other: AlphaGo played 4.9 million games against itself to learn how to beat a human world champion; GANs are made of two AI systems that compete against each other to generate images that look like ultra realistic photos. But what happens when AI systems support each other rather than compete? This is what happens in our ContrAI game. It is a wonderful example of a simple AI system supporting a much more complex AI system to perform better by improving the quality of the data it is consuming".

[Contributed by *i4.0 today*].

WORLD'S FIRST FULLY AUTOMATED MACHINE LEARNING PLATFORM

A pioneering machine learning platform that brings automation to every stage of the machine learning workflow for the first time has been launched by data science and analytics company Peak Indicators.

Known as the Tallinn ML, it provides all of the components required to build and deploy predictive models automatically without the need for a highly skilled data scientist, and has reduced the time required to produce powerful predictive analytics for big data from "months to mere hours".

A key element is the inclusion of a unique feature-engineering engine that drastically cuts the time taken to develop new predictive algorithms by generating and testing thousands of different metrics as part of the data engineering process.

The launch represents the culmination of two years of development by Peak Indicators' data science team in Chesterfield, with the Tallinn ML platform being tested in a series of technical challenges and piloted in a number of international organisations.

During testing with a global retail and consumer goods company Tallinn ML produced a predictive model in two hours that was 18 per cent more accurate and delivered 19 times fewer false positives than one developed over a three month period by a team of experienced data scientists.

In a global financial services organisation the use of Tallinn ML's automated feature engineering capability to enrich employee data improved the accuracy of employee churn predictions by 51 per cent. Tallinn ML produced a series of models that could be used around the world within a week of raw data being made available.

Professor Paul Clough, Head of Data Science at Peak Indicators, states:

"Until now, feature engineering was a complex, manual task that accounted for 80 per cent of the effort involved in delivering machine learning and predictive analytics projects. It was the last major hurdle in the end-to-end automation of data science. By automating this final piece of the jigsaw, we have reduced the time it takes to develop and deploy new models from months to mere hours, and enabled anyone to quickly become proficient in machine learning and predictive analytics on a big data scale."

"The launch of Tallinn ML is a major step forward in the world of data science, allowing people without data science experience to deploy highly accurate machine learning and predictive analytics quickly and at a significantly lower cost".

[Contribution by *i4.0 today*]

BREAKTHROUGH IN AUTONOMOUS INSPECTION AND REPAIR OF OFFSHORE WIND FARMS

One year on from the launch of one of the most ambitious offshore wind robotics projects ever undertaken, MIMRee (Multi-Platform Inspection, Maintenance and Repair in Extreme Environments) has broken new ground in the field of offshore inspection and repair.

The objective is to demonstrate successful operation of an autonomous system capable of planning its own operational missions to offshore wind farms, whereby a 'mothership' scans moving turbine blades on approach and then launches teams of inspection drones equipped with robotic blade crawlers that conduct forensic inspection and repair of damaged blades.

The system has been piloted at the Offshore Renewable Energy (ORE) Catapult Levenmouth Demonstration Turbine off the coast of Fife where the Thales imaging system has achieved blur-free images of moving wind turbine blades. The scanning of such blades for defects, without having to stop the turbines for days at a time is noted to be a "game-changer" for wind farm operations.

Another aim of the project is to demonstrate an integrated inspect-and-repair system for wind turbine blades utilising the BladeBUG robot, which has proved its walking abilities on a variety of blade surfaces at the ORE Catapult National Renewable Energy Centre.

In this connection the following milestones have been reported:

(i) An autonomous repair arm has been developed at the Royal College of Arts Robotics Laboratory that can rapidly switch between modules for cleaning, sanding and top-coating of damaged areas of blades, providing real-time feedback visualisation and human-in-the-loop teleoperation of repair tasks via a user-interface system.

(ii) Following experimentation with visible and short-wave infrared image capturing, Plant Integrity has produced the blade crawler's non-destructive testing (NDT) payload,

incorporating a module that uses an advanced machine-learning algorithm and a precision scanner for the achievement of exact measurement of defects under a wide variety of ambient light conditions.

(iii) An electronic skin, known as Wootzkin, patented by high-tech robotics company Wootzano, has been produced that enables the robot to 'feel' the surface of the blade and determine the surface conditions of the blade so that it can walk along it. Wootzkin also enables the robot's existing vacuum system to attach onto the blade more accurately using supervised machine learning algorithms.

Martin Bourton, Project Lead at Plant Integrity, states:

"This time last year we could talk about a spectacular concept. A year in, we can say that MIMRee is not futurology, but an imminent possibility with a host of technological breakthroughs achieved. The project is developing a variety of spin-off technologies: the ability to scan a working turbine, without stopping it for days while it is inspected, is just one with a very obvious benefit to industry."

The MIMRee planning software developed by Professor Sara Bernardini of Royal Holloway University has been integrated with the Thales vessel and the inspection drones have been developed by a team from the Universities of Manchester and Bristol. The drones have successfully co-ordinated launch, recovery and navigation from the vessel.

The MIMRee project is funded by means of a £4.2 million grant from Innovate UK.

[Contribution by *i4.0 today*].

SENSYNE LAUNCHES NEW CLINICAL ALGORITHM



Clinical AI company Sensyne Health has launched its SENSE system in the UK in partnership with Microsoft.

SENSE is a clinical algorithm engine which generates AI algorithms known as SYNEs for real-time support across multiple medical conditions. These SYNEs enable clinicians and healthcare systems to input up-to-date information concerning patients, which is then analysed using machine learning against the SENSE database of patients so as to provide advice with which to make clinical decisions.

Sensyne has signed its first agreement with Chelsea and Westminster Hospital NHS Foundation Trust for an algorithm produced by the SENSE system, known as SYNE-COV, which aims to provide more personalised care for patients with COVID-19, integrating data into an existing real-time dashboard enabling clinicians to augment their clinical decisions with near real-time risk prediction for three outcomes, namely risk of ICU admission, the need for mechanical ventilation and in-hospital mortality.

Lord (Paul) Drayson, PhD, CEO of Sensyne Health, states:

"The SENSE system is a major step forward in unifying different elements of our clinical AI technology together with Microsoft's health cloud technology to deliver multiple clinical algorithms at scale. We are delighted to announce the first SYNE algorithm from this approach, developed in collaboration with Chelsea and Westminster NHS Foundation Trust, designed and built to help the NHS cope with a potential second wave of COVID-19."

Further SYNE algorithms for different conditions are currently being developed and Sensyne aims to launch its SENSE system and associated SYNE algorithms in the US towards the end of the current financial year.

The partnership with Microsoft and use of Microsoft's new health cloud technology will enable SENSE, and the algorithms produced by it, to be deployable globally.

[Contribution by Rapid Medtech Communications Limited].

REDUCING CHIP COUNT IN GPS NAVIGATION



In order to address the challenges of navigation systems implemented in power-constrained IoT devices Nestwave has combined its soft core GPS navigation IP with the Synopsys Design Wave ARC IoT Communications IP Subsystem to produce a new low-power global navigation satellite system (GNSS) which can be integrated into IoT modems. Unveiled at the Synopsys

ARC Processor Virtual Summit on 9th. September, it provides designers with a power-efficient, high accuracy GPS solution for battery-operated devices without incurring the additional cost of a dedicated GNSS chip.

The ARC IoT Communications IP Subsystem is an integrated hardware and software solution that combines the Synopsys DSP-enhanced ARC EM9D processor, hardware accelerators, dedicated peripherals and RF interface to deliver efficient DSP performance for low bandwidth IoT applications. The Nestwave GNSS solution utilises the ARC EM9D processor's efficient DSP capabilities and ability to add dedicated hardware accelerators or custom instructions using APEX technology to reduce frequency requirements, so providing additional performance bandwidth.

The ARC EM9D processor is supported by the MetaWave Toolkit, which includes a library of DSP functions, allowing software engineers to rapidly implement algorithms from standard DSP building blocks.

Nestwave has developed a new low-power, advanced GNSS solution which, when integrated with an IoT modem, such as NB-IoT, Cat M1, LoRa or Sigfox, does not require an external GNSS chip to deliver low-cost geolocation for emerging applications such as asset tracking, smart factories and smart cities.

Ambroise Popper, CEO of Nestwave, states:

"By combining Nestwave's low-power geolocation software with Synopsys' efficient ARC IoT Communications IP Subsystem, we can deliver a geolocation solution that offers greater accuracy, lower power consumption, and lower cost compared to existing GNSS solutions."

[Contribution by softei.com].

NEW INVESTMENT PROGRAMME FOR AI IN NHS



The Government has announced a new investment programme for the deployment of artificial intelligence technologies in the NHS.

Managed by the Accelerated Access Collaborative in partnership with NHSX and the National Institute for Health Research, the £140 million AI in Health Care Award Programme forms part of the NHS AI Lab, which has been established to drive the adoption of data-driven technologies in the NHS.

Of this some £50 million is dedicated to the testing and scaling of a range of AI-powered innovations for the analysis of breast cancer screening scans and the assessment of emergency stroke patients, whilst take-home technology includes devices and software that allow smartphones to be turned into clinical grade medical devices that monitor kidney disease, and wearable patches for the detection of irregular heartbeats, a leading cause of strokes and heart attacks. There is also funding to support the research, development and testing of promising ideas that could be used to speed up diagnosis or improve care for conditions such as sepsis, cancer and Parkinson's Disease.

Successful products include:

* Health IO - an AI powered app that turns a smartphone into a clinical grade medical device capable of detecting albuminuria (an early warning sign of chronic kidney disease).

* iRhythm Technologies' ECG monitoring patch and service that utilises AI-led processing and analysis to help diagnose atrial fibrillation.

* Brainomix digital tools for assessment of emergency stroke patients, already successfully deployed at the Royal Berkshire NHS Trust.

Justin Hall, General Manager and Vice President EMEA at iRhythm Technologies, states:

"The UK is home to some of the most cutting-edge, life-changing medical technologies. However, it is still taking years for medical devices to go from clinical trial to widespread adoption, meaning neither patients nor practitioners are seeing the many benefits of these innovations. We're absolutely delighted to have been chosen as part of the pilot to change that."

Chief Executive of the NHS Sir Simon Stevens adds:

"We're still in the early stages of AI, but when the latest chapter in the history of medicine comes to be written, AI in healthcare will doubtless rank alongside earlier advances such as the stethoscope, the X-ray and the blood test."

[Contribution by *Med-Tech Innovation*].

NEW MICRO-PRECISION 3D PRINTER FOR SHORT-RUN INDUSTRIAL PRODUCTION

Boston Micro Fabrication (BMF) has launched a micro-precision 3D-printer, known as the microArch S240, specifically designed to meet the needs of short-run industrial production.

It is based on BMF's patented Projection Micro Stereolithography technology known as P μ SL, which allows for the rapid photopolymerisation of an entire layer of liquid polymer using a flash of ultraviolet light at micro-scale resolution. The superior production of intricate, exact and replicable parts makes the technique optimal for end-part and prototyping across a wide range of industries, including electronics, medical device manufacturing, microfluidics, MEMS, biotech and pharmaceuticals.

Key features include a larger build volume (100 x 100 x 75mm per 750 cubic centimetres) and up to ten times faster print speeds, enabling the production of larger parts, or a higher throughput of smaller parts, while still achieving the same 10 μ m resolution plus or minus 25 μ m tolerance as other BMF printers. Users can print using a number of industrial-grade materials with attributes, including mirror finishes, sharp edges and smooth channels, that are suitable for end-use applications or prototypes meant to seamlessly mirror end parts.

Of particular note is the ability to print industrial-grade composite polymers and ceramics, including an all-new functional engineering material developed in collaboration with BASF. BMF RG material from the Forward AM Ultracur3D photopolymer resin line is being introduced for use on the microArch 240 with high strength and durability properties, and the capacity to handle molecular weight materials with viscosities of up to 20,000 Cp enables the production of stronger functional parts.

John Kawola, Chief Executive Officer Global for BMF states:

"Until now this coveted combination of quality, strength and resolution had been missing from industrial production, particularly for use cases that require high precision and micron level resolution. With the microArch S240, users can finally make end-use micro parts at speeds that are required for production, with resolution, accuracy and precision that is true

to CAD. Smaller parts no longer need to mean bigger price tags for manufacturers and engineers."

Oleksandra Blacka, Business Development Manager, Photopolymers, Medical and Dental for BASF, adds:

"The new BMF RG material from the Forward AM Ultracur3D photopolymer resin line will enable users to achieve ultra-high resolution of their parts. The microArch 240 printer is addressing a market that has previously been unserved. This collaboration will now enable customers, especially in the medical industry, to assemble complex items that were too small to handle on previous printing platforms."

[Contribution by *Med-Tech Innovation*].

FIRST VISION SYSTEM FOR AI DEFECT DETECTION



Visual inspection experts Omron have pioneered what is believed to be the world's first vision system that uses artificial intelligence to detect defects.

The FH series vision system identifies defects without learning samples. The image processing system identifies subtle defects with human-like sensitivity in order to achieve

higher defect detection rates. Scratches and blemishes that were once difficult to capture can therefore be identified even without the use of samples or adjustment.

The AI technology reproduces the human sensibility of skilled inspectors to detect defects that were once difficult to capture. The FH series vision system can determine acceptable variation tolerances. An AI fine matching tool 'learns' from the image data of non-defective products to quickly acquire the expertise that inspectors develop over many years. The system can thus be automated while ensuring the reliable identification of subtle defects even on flexible lines that produce a wide range of items.

According to Omron AI has now reached a point where it can be used to recognise object features as well as humans and automatically learn criteria. This AI is now part of the FH series.

The system is noted to be particularly suited to the COVID-19 environment where people are required to avoid working in the same space at manufacturing sites and there is increased demand for labour saving automated visual inspection.

[Contributed by *softei.com*].

FIRST PRODUCTION-READY 4D IMAGING RADAR FOR AUTONOMOUS DRIVING

The first production-ready 4D imaging radar for autonomous driving has been launched by Continental.

The Advanced Radar Sensor 540, or ARS540, is based on the Xilinx Zynq UltraScale+ MPSoC platform and newly produced vehicles that are equipped with it are able to realise SAE J3016 Level 2 functionalities, paving the way toward Level 5 autonomous driving systems.

4D imaging radar determines an object's location in range, azimuth, elevation and relative speed so as to provide detailed information about the driving environment. Previous automotive radar systems have merely caught the speed and azimuth or angle between the Sun or Moon and the North to determine the direction of the Sun or Moon.

The ARS540 is a premium, long-range 4D imaging radar with high resolution and a 300-metre range. Its wide, plus or minus 60 degree field of view enables multi-hypothesis tracking for precise prediction while driving. This helps drivers manage complex driving scenarios, such as detection of a traffic jam under a bridge. The high horizontal and vertical resolution of the ARS540 detects potentially hazardous objects on the road and responds appropriately. The ARS540 is scalable, supporting SAE Level 2, where the driver is responsible for supervising vehicle control, and extending to fully autonomous Level 5.

The Xilinx Automotive Zynq UltraScale+ MPSoC is an adaptable platform that allows Continental's 4D imaging radar to be agnostic to multiple sensor-platform configurations and adapt to OEM specification. Parallel processing within the programmable logic of the device delivers optimal performance and enables the fully independent yet simultaneous processing pipelines for the 4D sensing by the ARS540. The multiple DSP slices enable hardware acceleration of real-time radar sensor inputs.

Cedric Malaquin, Technology and Market Analyst for RF Devices and Technology at Yole Developpement, states:

"4D imaging radar provides greater range, field of view and perception and is a critical sensor enabling Level 2 to Level 5 developers to deliver systems that help create a safer driving environment. We expect 4D imaging radar to take place in luxury cars and robotaxis at first, leading to over \$550 million, a rise at a compound annual growth rate of 124 per cent between 2020 and 2025."

[Contribution by softei.com].

CYBER PROTECTION FOR WORLD'S FIRST ELECTRIC FLYING CAR RACING SERIES



Airspeeder, the world's first electric flying car racing series, has announced a landmark partnership with cyber protection company Acronis.

Under the partnership the racing series, created by performance electric car manufacturer Alauda, will receive technical and commercial support from Acronis that will ensure the data security for the revolutionary LiDAR and Machine Vision technology which will deliver close but safe racing through the creation of virtual force-fields around each racing craft or 'Speeder'.

Part of the technology will be supplied by Tecnov8, a global provider of Cyber-security solutions, and the accelerated development of this technology is expected to greatly benefit the electrical vertical take-off and landing (eVTOL) industry sector that is backed by Uber, Daimler, Toyota, Hyundai and Airbus and anticipated by Morgan Stanley to be worth \$1.5 trillion by 2040.

The partnership between Airspeeder and Acronis is seen as further affirmation of the strategy of Airspeeder and Alauda to accelerate the next great mobility revolution through sporting competition.

Described as the 'Formula One of the Skies' Airspeeder is a racing series conceived by Alauda and will involve elite pilots selected from aviation, motorsport and eSports navigating electrically governed courses. Electric racing 'multicopters' created by Alauda will fly at speeds of up to 130 km/h. Airspeeder GP seasons will be contested by teams who will purchase the original craft and equipment from Alauda, the Airspeeder series' exclusive manufacturer, but will have freedom to set race strategy and recruit pilots.

Success for teams will derive from the skill of the pilots combined with the team's ability to maximise performance from a revolutionary technical platform. Key to this will be the collection and interpretation of data, which will be underpinned by Acronis' solutions that ensure the secure and seamless management of data. Key indicators from battery peak performance to pilot biometrics will be available to teams as they plot their strategy to gain competitive advantage.

Matt Pearson, Founder of Alauda and Airspeeder, states:

"At Airspeeder we are creating an aerial motorsport driven by innovation. Backing from Acronis, a business with an extraordinary culture of technological success in Formula One and Formula E, represents significant affirmation of our vision to accelerate the next great mobility revolution through sporting competition."

[Contribution by *Data Centre Review*].

THIN WAFER CLEANING SYSTEM FOR HIGH-VOLUME POWER SEMICONDUCTOR DEVICE MANUFACTURING



ACM Research Inc., a leading supplier of wafer-processing solutions for semiconductor and advanced wafer-level packaging applications, has launched a high-throughput, four-chamber thin wafer cleaning system designed for single-wafer wet processes, including cleaning, etching and surface finishing.

The system is intended for the manufacture of both metal-oxide-semiconductor field-effect transistor (MOSFET) and insulated-gate bipolar transistor (IGBT) devices for the power semiconductor market, and features complete touch-free handling and processing based on the Bernoulli effect to eliminate possible wafer damage and improve final device yield.

The handling system is programmable to accommodate Taiko wafers down to 50 micron thickness, ultra-thin wafers of less than 200 micron thickness, high aspect ratio (greater than 10:1) deep-trench wafers, double thickness bonded wafer pairs as well as 200mm and 300mm Si wafers.

The robot arms for loading and unloading, as well as the chuck, have been designed for non-contact wafer handling using a proprietary method based on the Bernoulli effect whereby nitrogen gas provides constant pressure to keep the wafer floating in place on the arm. The

arm can then be flipped for processing on either side while still holding the wafer in place. This allows for the handling of high-warpage wafers without contact.

During the wet process, the wafer sits front-side down on the Bernoulli chuck with the nitrogen flow cushioning the wafer, protecting it and keeping it dry. This proprietary design, using ACM's patented technology on a Bernoulli chuck, features a recipe-controlled gap between the wafer and chuck to meet requirements for undercut width control on the wafer device side edge, as well as pin-mark-free control. The system can also be configured to include an optional thickness measurement function.

Once mechanical grinding/polishing has been performed to achieve desired thickness, the handling system supports these ultra-thin, high-warpage wafers throughout subsequent critical processes, including silicon thinning, using a wet-etch step to eliminate microcracks. Additionally, by implementing a different combination of chemistries, this tool can also be used for cleaning, photoresist removal, thin-film removal and metal etching.

Each chamber can be configured with up to four swing arms for delivering process chemistries such as wet etchants, solvents, RCA cleaning chemicals, deionised water and nitrogen, with the chambers also designed to allow for the reclaiming of two types of chemicals.

David Wang, Chief Executive Officer and President of ACM, states:

"To compete for market share, power device manufacturers must expand their MOSFET and IGBT manufacturing lines to include wafer thinning equipment without significantly increasing the overall lab footprint. We have responded by developing a four-chamber tool that offers much higher throughput than the currently available two-chamber systems. Additionally, we outfitted the tool with a proprietary contactless handling and processing system to prevent these fragile wafers - which can be as thin as 50 microns - from being damaged during the backside thinning and cleaning processes, thereby increasing overall device yield."

Yole Developpement, a market research and development firm, predicts that the market for thinned wafers will increase from 100 million in 2019 to 135 million by 2025, representing a

compound growth rate of over 5 per cent. This is expected to derive from increased demand for memory, CMOS image sensors and power silicon carbide components, as well as LED and laser diodes.

Additionally, Mordor Intelligence reports that sales of electric cars in Europe, North America and China are creating new avenues for IGBTs to support infrastructure and manufacturing of electric vehicles.

References:

1. <https://www.mordorintelligence.com/industry-reports/insulated-gate-bipolar-transistor-igbt-market>
2. http://www.yole.fr/iso_upload/Mews/2020/PR_THINNING_EQUIPMENT_MATERIALS.Technology_Market_Overview_YOLE_June2020.pdf

[Contributed by *SMT Today*]

AUTOMATION WITHOUT CABINETS

This article, by Bradley McEwan, Business Development Manager for Beckhoff Automation UK, in the September 2020 issue of *Controls, Drives and Automation* (p.26-27), explains how concerns about machine real estate, that is how square metres of plant space contribute towards revenue, are growing among manufacturers, and the role that modular units are playing in reclaiming valuable floor space.

Modular units are seen as having many advantages, such as being faster to implement in new spaces and integrate into existing production lines, but with these advantages come the challenges of connecting, integrating and powering these machines. In order to address these the author suggests that new approaches to machine design and functionality are required:

'One such approach relates to the control panels of machinery. Control panels can sometimes take up several metres of space in a production line - machine real estate that could otherwise be devoted to production. Furthermore, it is often the case among manufacturers that goals to reconfigure or expand production lines lead to an increasing number of mounted devices.'

'Saving space in control panels with downsized components is, therefore, the way forward in cases like these. This is a challenge when the number of devices used in control panels is increasing, due to more advanced and more composite machine functionality.'

The author then describes how Beckhoff proceeded to address this challenge:

'The resulting solution was to remove the control cabinets and build the automation components into the structure of the machine itself. The idea of a panel-less machine complements Beckhoff's concept of "automation without cabinets" whereby the size of the control cabinet is minimised. Whereas previously there were space requirements in the cabinet for the controller, servo drives and inputs/outputs this can now be drastically reduced by the automation without cabinets concept.'

'With the AMP8000 servo drive, the machine's power electronics have been moved directly to the machine. This reduces the required space in the control cabinet to house essential functions like incoming power, power distribution, isolators and fusing.'

'More specifically, the system integrates a safety rated servo drive in a very compact design, directly into the servomotor. This unique technology takes away the need to increase the motor's frame size for a given power, which sets the system apart from Beckhoff's competitors and is beneficial for modular machine concepts.'

One Cable Solution

Another innovation from Beckhoff is its so-called 'one cable solution', which complements the AMP8000. With this a single cable runs through the machine connecting multiple distributed servo drives and input/output systems via a distribution module, the idea being that reducing the cabling drastically to plugs and sockets also reduces wiring and errors:

'The key technology here is EtherCAT P, a new development in EtherCAT technology on the cabling level. The "P" stands for power and allows the use of standard four-wire Ethernet cable, but also for two electrically isolated, individually switchable 24 Volt (3 Amp) power supplies.'

'With EtherCAT P, multiple EtherCAT devices can be connected and complex machines or machine lines can be implemented with simple topologies. As a result, only one cable is required to connect and power inputs/outputs and other field devices, including servo drives.'

'The Beckhoff EtherCAT P I/O portfolio is comprehensive. Instead of having to use multiple connection cables between a control cabinet and a machine, a single cable to the AMP8805 distribution module is all it takes because each of the AMP8000 distribution servo drives is, in turn, connected to the distribution module with just a short cable. With EtherCAT P, the cable routes to the motor can be laid out much more clearly, and space requirements in the control cabinet are reduced to a minimum.'

'Furthermore, only one cable type is required for the entire system cabling. Also, preassembled system cables significantly reduce the time and cost required for logistics, cabling, and commissioning, and minimises the risk of error.'

The author concludes:

'With these technologies, it is now possible to develop systems that pack high performance and functionality into smaller footprints for automation engineers and plant managers. These systems no longer require complex, bulky control cabinets. Instead, machines require as little as a single compact distribution module.'

MED-TECH INNOVATION AWARDS

This year's live Med-Tech Innovation Awards evening, and the accompanying Med-Tech Innovation Expo, has been postponed until June 2021, but in order to ensure that the excellent work and advances of 2019 and 2020 receive recognition *Med-Tech Innovation News* has temporarily taken over from the live events team and published the full list of 2020 Finalists in issue 49 of its journal.

A panel of judges has selected the Finalists under five categories.

3D Printing

This category requires entrants to demonstrate how 3D printing has enhanced or fundamentally improved the design or manufacture of a medical device. This could be as a design development aid, a manufacturing jig or fixture, or the additive manufacturing of end-use products. The Finalists in this category are:

* Axial 3D for a surgical model service that uses machine learning algorithms to assist in the conversion of patient scan data to 3D anatomical models resulting in reduced lead times.

* ExpHand Prosthetics for the development of affordable, expandable and customisable 3D-printed prosthetics for children between the ages of three and ten, with an adjustable universal socket that can be fitted at home by parents.

* FabRx Limited for its M3dimaker 3D-printer that prints solid oral medicine to meet specific health and therapeutic requirements in a single tablet.

* MedScan3D for a 3D-printed anatomical surgical model service using expert adaption to produce anatomically accurate silicone test simulators for medical devices.

* University of Liverpool for a digital electronic imaging system to enhance the quality control of the EBAM additive manufacturing process to improve reliability in the manufacturing of bespoke orthopaedic implants.

Connected Health

In this category entrants will have played a part in the design or manufacture of a cutting-edge connected medical device. Examples include the supply of miniaturised sensors or conductive materials, or involvement in the production of assembly specific components, or the provision of software and digital services. The Finalists are:

* AinoStics Limited for development of an AI analysis engine that uses multi-modal patient data (such as scans, patient records and wearable sensors) to perform highly accurate diagnosis and prognosis for early dementia.

* FeelTect for a connected wearable device, known as Tight Alright, that measures and monitors sub-bandage pressure during compression therapy, reducing healing times and improving quality of life.

* Game Doctor for development of a healthcare analytics and education platform that uses mobile gaming to map and predict health behaviours in patients and the public.

* The London Ambulance NHS Trust for an online Point of Care Testing service that enables en route pathological testing with results available online for the destination hospital, reducing patient treatment time and improving clinical outcomes.

* Nemaura Medical Inc. for SugarBEAT, a non-invasive continuous glucose monitor and lifestyle app for diabetes that provides a personalised and progressive behaviour change app to help manage and prevent Type 2 diabetes.

Design

In this category entrants are required to demonstrate how design principles have been used to create a futuristic solution to meet a clinical need. This requires a description of the detail and complexities involved in designing the product, plus details of material and processing decisions that were made in order to enable the design to be successful. The Finalists are:

* NEMERA for a smart drug delivery device called Safe 'n' Spray that incorporates a reusable child-resistant locking unit and fingerprint identification to monitor drug delivery and prevent overdosing.

* Oxford VR for a virtual reality therapy platform with a computer-generated virtual coach for personalised treatment of mental health conditions which, following successful clinical trials, has been adopted in four NHS trusts.

* SleepAngel, a patented medical barrier bedding that allows the bedding to breathe whilst providing a 100 per cent barrier to allergens and pathogens, so reducing hospital-acquired infections and increasing sustainability in the hospital setting.

* The Moment for M-co, a non-invasive wearable device that utilises pulsed cueing and focused vibrotactile stimulation to ease the symptoms of Parkinson's Disease.

Engineering

This category requires an idea which has resulted in breakthrough or improvement in the manufacture of a specific product or component. Examples could be re-evaluation of a part design, or selection of a different material to overcome a specific issue, with the benefits of the strategic decision highlighted. The Finalists are:

* Biovation Orthopaedic Solutions Limited for redesign of an instrument kit used to perform cartilage replacement implant surgery for big toe arthritis that eliminates pre-operative lead times, lowers manufacturing costs and enables more accurate surgery.

* Carclo Technical Plastics for specialist in-tool process control and monitoring equipment for the injection moulding process of a drug delivery device, improving quality control and reducing inspection costs.

* Emerson for development of a micro solenoid valve for use in portable oxygen concentrations that is light and compact and has a higher flow rate than competing valves, improving quality of life for the user.

* Freudenberg Medical (sponsors of the Awards) for its Helix iMC technology which continuously measures the inner geometry of silicone tubes during the extrusion process so as to improve product quality and productivity, as well as reducing waste and time to market.

* Marsden for its Patient Transfer Scale, a transfer board with an in-built weighing scale that enables immobile and time critical patients to be weighed instantly and accurately to allow for the precise administration of drug doses and treatment.

Materials Innovation

This final category recognises new and ground-breaking material, and applications where material choice has been pivotal to the success of the final product. The Finalists are:

* 3M Medical Materials and Technologies for a set of advanced solutions for stick-to-skin wearable devices, known as the 3M Extended Wear Medical Transfer Adhesives Suite, that provides water resistance, breathability, elasticity and long wear times.

* PAXXUS for StreamOneR, an ultra-high barrier, hermetically sealable medical packaging solution for the number one polyester recycling stream, providing a higher performing and sustainable alternative to polypropylene medical packaging.

* Spyras for development of an affordable, disposable, paper-based wearable device for continuous real-time breathing analysis in hospitals, which is designed to automatically alert clinicians to early signs of patient deterioration.

* Stratasys for development of specialised digital materials that permit the Stratasys Digital Anatomy Platform to replicate human anatomy which has the same biomechanical properties as native bone and tissue for realistic anatomical models.