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ENGINEERING DESIGN SHOW 2017

The Engineering Design Show, now in its sixth year, was held at The Ricoh Arena, Coventry, on 18th. and 19th. October. Incorporating The Electronics Design Show and The Embedded Design Show, the event featured around 240 exhibitors and 50 presentations, which were subdivided into The Eureka Conference, The New Electronics Conference and various workshop presentations.

Subjects included 'Intelligent Technology: How Virtual Reality can be used in Design Engineering', 'The Future of Drone Deliveries', 'Launch UK: Opportunities in Space for Design Engineers', 'The World's first firefighting Thermal Imaging System', 'Molecular Imaging to guide Cancer Surgery', 'Transforming Electronics with 3D Printing', 'Latest Developments in Autonomous Vehicle Technology', 'Simulating Physics in Product Design', 'Designing a Hardware-accelerated Rock Paper - Scissors Robot using affordable Kits', 'Practical Uses of Red Pitaya - The ultimate Open Source high-speed Platform', and 'Increasing the Functionality of Bluetooth for IoT using Bluetooth 5'.

Below are some more up-to-date developments.

3D PCB PRINTER REDEFINES ELECTRONIC PROTOTYPING

One of the major innovations showcased at this year's event was the DragonFly 3D PCB printer from Nano Dimension, which is redefining electronics prototyping by enabling the production of 100 per cent additive printed circuit boards.

In electronics development traditional manufacturing techniques have resulted in long and expensive lead times, with the time taken for numerous design iterations having a significant impact on product development projects. The DragonFly 3D PCB printer has been developed together with a suite of nanotechnology conductive and dielectric inks so as to be able to overcome these obstacles.

Nano Dimension state:

'DragonFly 2020 Pro 3D printers enable companies involved in electronics to take control of their development cycles by 3D printing their own circuit boards. From proofs of concept to design validation to test fixtures, in-house printing of multilayer PCBs shortens design and test cycles, from months or weeks to days. Development teams can now introduce more agile hardware development processes at every processing stage.'

'Nano Dimension's extremely precise inkjet deposition system allows for simultaneous 3D printing of conductive silver nanoparticle ink (metals) and insulating inks (dielectric polymers). This sets new standards for accuracy, complexity and speed in the fields of both 3D printed electronics and professional electronics development. Upon completion of a 3D print job, there is no need for post processing. Multi-material 3D printing is game-changing, allowing designers and engineers to print polymers and metals together to create a functional part. This is a revolutionary approach to making electronics with the potential to be more compact, denser, and ultimately non-planar.'

In *New Electronics*, 26 September 2017, Materials Manager for Nano Dimension, Robert Even, in his article 'An In-house Prototyping Revolution' adds:

"Using in-house 3D printers, designers can create multilayer electronics in a matter of hours. The process even enables the printing of complex elements - such as vias in pads, blind or buried vias and through-holes - without the need for etching, drilling, plating or generating waste. The dielectric serves as a solid support within which the conductive drops are deposited, layer by layer, at the precise XYZ coordinates specified to create the traces and interconnects. The printer will produce a fully functional multilayer circuit in one overnight print job. Upon completion, the multilayer 3D printed PCB is ready for soldering.

For designers the process is as straightforward as loading the design file straight to the 3D printer and then printing. The Nano Dimension Switch software (job editor) accepts common file formats in the electronics industry - Gerber and Excellon - streamlining prototype fabrication significantly. Multilayer 3D files can be edited and prepared from standard files, and the software allows for adjustments to numerous parameters such as layer thickness. Starting from a sacrificial substrate, the materials are built up from the underside conductive traces and solder mask, to finish with the topside pads and solder mask.

The DragonFly 2020 3D printer is the first device in the industry that enables electronics companies to create their own professional, high resolution multilayer PCBs and 3D circuitry for rapid prototyping and small-scale production - printing a PCB layer by layer."

Further Information

Nano Dimension is headquartered at 2 Ilan Ramon st, Ness Ziona Science Park, Israel. www.nano-di.com

COMPUTER SIMULATION TECHNOLOGY SOFTWARE UPGRADED

Computer Simulation Technology (CST) is a market leader in providing 3D electromagnetic (EM) field simulation tools, and their latest product, CST STUDIO SUITE® 2017, a package of high-performance software for the simulation of EM fields in all frequency bands, includes a number of new additions.

Filter Designer 3D

Cross-coupled filters offer a compact and high-performance method of using the electromagnetic spectrum, but their complexity and sensitivity makes them challenging to design using traditional methods. Filter Designer 3D can automatically synthesize cross-coupled and diplexer filter designs to meet the specifications, including transmission zeroes, Q-factor and equiripple.

The company states:

'Filter Designer 3D can calculate the coupling matrix upon which the filter engineer can base a design, or produce a full filter model that can be used as the basis of an optimisation or system simulation using the full-wave 3D solvers of the software.'

Antenna-to-Antenna Coupling

System integrators and electromagnetic compatibility (EMC) engineers frequently need to know how antennas on a shared platform couple to each other. On smaller platforms the CST® Time Domain Solver and Integral Equation Solver already work efficiently for antenna coupling simulation, but the 2017 version now allows this capability to be extended to much larger platforms.

The company states:

'The ray-tracing Asymptotic Solver (A Solver) in CST STUDIO SUITE can now directly calculate the coupling between antennas. The A Solver can simulate extremely large platforms such as aircraft, ships and buildings very efficiently, making it well suited to many kinds of antenna placement scenarios.'

Interference Task

Electromagnetic interference between subsystems, such as antennas on a platform or channels on a PCB, is a vital consideration in many applications. The new Interference Task provides a straightforward means of investigating EMI issues using coupler data from simulations, including results from the A Solver. EMI problems can now be identified and mitigation methods tested on a virtual prototype.

Conjugate Heat Transfer Solver

Thermal effects are often critical in high-power or high-speed applications because overheating can result in thermal expansion, which can detune and potentially damage the device.

The accurate simulation of these effects requires multiphysics simulation, with EM and thermal solvers linked together. The new Conjugate Heat Transfer Solver therefore uses computational fluid dynamics to simulate the flow of air through devices, taking fans and vents into account. Users can now include the cooling systems in their multiphysics simulation, allowing these systems to be designed and optimised before constructing prototypes.

Array Wizard

The Array Wizard is already a well-established feature in CST STUDIO SUITE, automatically guiding users through the array design workflow, from simulation of the individual element to automatic construction of the entire array. The 2017 version, however, adds support for non-periodic and arbitrary 3D arrays, which is said to 'broaden the use cases for the tool significantly.'

Further Information

Computer Simulation Technology AG was an exhibitor at The Electronics Design Show and is based at Badnaheimer Strasse 19, 64289 Darmstadt, Germany. Telephone: +44 1159 061 120. Email: info@cst.com

CASE STUDY: CONVERGENTIA

Convergentia is the world's first 'virtual build factory' and specialises in the provision of virtual prototyping services to customers in a wide range of industries, including the consumer electronics market.

Portable devices such as smartphones and tablets contain a variety of wireless systems, including cellular, WiFi and GPS. Each system requires a functional antenna, and poor antenna performance can lead to low data throughput or poor coverage meaning that calls can become dropped and car navigation systems, for example, can fail. The thinness of the devices combined with the presence of metallic structures have made antenna design challenging. Multiple prototyping rounds in particular are costly, have a long lead time, and lack the ability to study some important features, such as grounding structures and impedance matching networks.

3D simulation can help, but simulated results have to correlate with measured data in order to build confidence in the simulated data.

Convergentia found that when discrepancies between the two arose these tended to be due to the lack of similarity between the simulation model and the prototype, since it is not possible to 'one-to-one' model all of the complicated structures such as display, touch sensor or speaker. Furthermore, material properties can be unknown at the frequencies of interest. Antenna designers therefore have to judge how to model the parts that cannot be used directly from the 3D model and for this CST STUDIO SUITE was investigated as a potential tool.

CST state:

'Most modern integrated antennas include either lumped components or RF switches for impedance matching, although due to the vast amount of frequency bands within LTE, chipset suppliers have started to include integrated antenna matching tuners in their circuitry. In the early phase of the R and D process, tuning elements can be designed with circuit simulators, but for a working prototype layout simulations are a must. This is especially important at higher frequencies (over 1.7 GHz) when layout parasitic effects can become dominating.

Traditionally, antenna tuning is done with a network analyser by optimising the return loss of the antenna. Without a matching network, a good impedance matching usually also ensures good radiation properties. The efficiency of the antenna can be checked in an an-echoic chamber. This design process cannot be used for antennas with a matching network, because good impedance matching may consider more the losses in the network than good radiation of the antenna. With combined antenna and layout simulations, engineers can avoid additional PCB design rounds and skip the tedious and slow antenna tuning process.

Antennas require a proper ground plane in order to function correctly. This can be difficult to realise in a small device with several separate metal parts. Creating a good ground plane on a device means that the metal parts should be connected together so that maximum antenna performance is achieved.

If the grounding structure is not properly designed, it may result in insufficient bandwidth or there may be unintentionally created RF traps, which increase the antenna loss several decibels. These kinds of lossy resonances are well-known to antenna designers and are very difficult to track and correct in prototypes. It may take weeks to find the cause of these problems, and a new prototyping round would be needed in order to fix the problem. Simulation made it possible for designs to be examined without the cost of constructing a prototype, and field visualisation allows resonant components to be identified by eye.'

Virtual prototyping allowed the number of prototyping rounds to be reduced, along with device development time. One reason for this was the absence of the need for mechanical changes or PCB changes due to antenna performance issues during physical prototyping.

The second reason was that because all antennas worked as constructed, testing of other areas could begin without the need to wait for the antenna designers to make the antennas work first. EMC and data throughput tests, for example, could commence immediately.

CST concludes:

'The prerequisite for the successful virtual build is that the simulation model corresponds with the upcoming prototype including the matching network layout and grounding structure of the device. The combination of the powerful CAD import tools and accurate solver technologies in CST STUDIO SUITE, together with Convergentia's simulation expertise, allowed them to implement an effective virtual prototyping workflow.'

Contact details as above.

NEW CALIBRATION RIG FOR LOW FREQUENCY CALIBRATION OF VIBRATION SENSORS

Accelerometers and velocity sensors are used to measure vibration at a wide range of frequencies, including the low frequencies found in building maintenance. These can occur at less than 2Hz and are useful, for example in monitoring bearing wear in cooling tower fans and gearboxes.

The calibration of these sensors at frequencies under 2Hz normally requires specialist equipment because the frequency range is too low for most test shakers. Monitran, however, has recently developed a test rig that can oscillate accurately at frequencies as low as 0.2 Hz, and in *Electronics* (September 2017) its Managing Director Andy Anthony, in his article 'Oscillating Beam Rig helps test Low Frequency Sensors', explains some of the technology underpinning its design.

He states:

"The horizontal linear beam oscillator has a powerful motion control system that incorporates a precision AC servo with 17-bit encoder feedback. Running on two precision rails, it uses magnetic springs and magnetic damping to ensure smooth operation. Its software produces fast code, at 1.7 milliradians per step, which generates fine sinusoidal motion for the linear track driven by a rotary motor.

The intelligent shuttle, which can carry a sensor payload of up to 0.5 kg, incorporates seven MEMS accelerometers, signal processing and a microcontroller to monitor its motion. It also includes a mechanical low pass filter and has an operating distance of up to 1,000 mm, exerting up to 8g acceleration to the devices under test. That amounts to over 35 km/h peak velocity, down to nearly one twentieth of walking speed.

Some of Monitran's ranges of accelerometers that operate at these low frequencies are the MTN/7000 series. Their piezoresistive sensor elements operate from 0 Hz to a few hundred Hz, depending upon the chosen operating range. Their low frequency response allows them to be used to measure very slow vibrations in massive structures, such as buildings adjacent to construction work that involves heavy duty machinery or tunnel boring machines, for example.

The units are sealed to IP65 and have an integral stainless steel over-braided cable. They are suitable for laboratory and light industrial environments, such as research and development, test rigs, slow rotating machines and structural monitoring."

INTRODUCING SMART WIRING

The wiring of control cabinets has traditionally been a costly manual process that has required qualified specialists who can interpret complex schematic documents. The correct wiring of components can typically account for up to 40 per cent of production time.

Now, EPLAN, an exhibitor at The Engineering Design Show, have developed Smart Wiring software that is browser-based and provides all of the data required for wiring control cabinets in digital format, considerably simplifying the operation.

The company states:

'Wiring lists with information on all connections can be provided in Excel format or directly from EPLAN Pro Panel inclusive of 3D mounting layouts. EPLAN Smart Wiring visualises installation requirements and the wiring needed. The programme guides users step by step through installation of the required connections until wiring is correctly set up within the control cabinet.

When data is transferred from EPLAN Pro Panel, routing tracks are portrayed based on a 3D layout of the virtual control cabinet. The 3D graphic automatically provides information about which devices are to be connected via which connection points as well as the correct wire routing track. When a connection has been correctly wired, it will be set to green according to the traffic light principle. When EPLAN Pro Panel is not being used, wiring takes place based on Excel connection lists.

EPLAN Smart Wiring describes each connection line for line. If a connection cannot be installed, e.g. because of missing wires or wrongly-sized cross sections, the connection is blocked or given a comment. The comment can also be emailed instantly to the electrical engineer to enable the error to be rectified. In the event of changes, the software automatically creates a project tab and the current status is displayed to all involved. An option to save the current processing status of a project allows, among other things, forwarding of project data from manufacturing station to manufacturing station in continuous production lines. This makes the production process significantly easier.

Synchronisation of the different editing stages takes place automatically within EPLAN Smart Wiring. The wiring technician thereby receives all the information of the changes to be performed. In such cases, the technician is also able to identify, via the traffic light principle, which connections have been removed and require de-installation as well as any new connections which have been added.'

Further Information

EPLAN Software and Services GmbH and Co. KG is based at An der alten Ziegelei 2, D-40789 Monheim am Rhein, Germany. Telephone: +49 (0) 2173 3964-0. Email: info@eplan.de

NEW MULTI-CHANNEL CONDITION MONITORING SYSTEM FOR MACHINE TOOLS

Schaeffler UK is a global automotive and industrial supplier, and was a Headline Sponsor of this year's Engineering Design Show.

At the show the company showcased a new multi-channel condition monitoring system (CMS) for machine tools which, in particular, enables condition monitoring and condition predictions for key components in machine tools using a single CMS, and permits the flexible integration of sensors from different manufacturers into the CMS.

The company states:

'Condition monitoring systems for machine tools must fulfil complex requirements with regard to the available space and the number of drive components to be monitored. Not only axes, feed drives and spindles, but also ancillary equipment such as hydraulic motors are important subsystems that can cause complete failure of a machine tool. In addition, manufacturers of subsystems and suppliers of ancillary equipment integrate their own measuring systems into machines. A CMS for machine tools must therefore enable sensors from different manufacturers to operate with the machine.'

'Piezoelectric vibration, force and pressure sensors from other manufacturers can be integrated into the CMS via an IEPE interface. This offers a major advantage in that operators can use the sensors that are available and suitable for the individual measuring point and measurement task. The current prototype has six measurement channels. The system is designed so that, for example, the electronic monitoring of the lubrication conditions in linear recirculating roller bearing and guideway assemblies can also be integrated in the future.'

With regard to the software, most functions, algorithms and the optional connection to the Schaeffler Cloud from other projects can be ported with only a minimal outlay :

'Due to the connection of the Schaeffler Cloud, all digital services offered by Schaeffler for monitoring and detecting damage to roller bearings are already available in the prototype CMS. As a local solution, the multi-channel CMS facilitates the monitoring of FAG roller bearings based on the integrated bearing catalogue, as well as bearings from other manufacturers (after entering specific bearing criteria).'

'A completely new development is the option to interpret vibration signals from ball screw drives. The beta version of the software module, which is currently in the testing phase, will be available to customers shortly.'

The system is currently being implemented in Machine Tool 4.0 at Schaeffler's manufacturing site in Hochstadt, Germany. This machining centre serves as a technology platform and development project for digitised products in the machine tool sector. Machine Tool 4.0 is used to develop and test the algorithms for the multi-channel CMS for monitoring and diagnosing the condition of roller bearings and components in machine tools under real conditions.

More information may be obtained from Schaeffler UK on 0121 313 5830. Email: info@schaeffler.com

ARTIFICIAL INTELLIGENCE FOR CONDITION MONITORING OF BRIDGES

Inspection tasks on bridges have traditionally been performed visually, but this is restrictive as inspectors can only see abnormalities or anomalies on the surface. Recently trials have been undertaken in which sensors have been attached to the surfaces of bridge decks in order to utilise vibration data to assess damage, but accurately interpreting the degree of internal damage existing remained an issue.

In response to this challenge Fujitsu Laboratories have expanded on their proprietary deep learning Artificial Intelligence technology for time series data enabling development of a system that can discover anomalies and express in numerical terms degrees of change that demonstrate drastic changes in the status of objects such as structures or machinery, and detect the occurrence of abnormalities or distinctive changes.

In *Design Products and Applications* (October 2017) the article 'Estimating internal Damage to Bridge Infrastructure' explains:

'The technology learns from the geometric characteristics extracted from complex, constantly changing time-series vibration data collected by sensors equipped on IoT devices, thus enabling users to estimate and validate the state of degradation or failure in a variety of social infrastructure or machinery.'

This newly developed technology was applied to vibration data collected from acceleration tests (wheel load running test) performed by the Research Association for Infrastructure Monitoring Systems (RAIMS). The results showed that the geometric characteristics extracted from the vibration data by this technology would appear as a single cluster when the bridge was intact, but the shape changes when the bridge had developed internal damage. Moreover, it was confirmed that the degree of abnormality and the degree of change that can be calculated by converting the geometric characteristics to numerical values correspond with the results measured by strain sensors embedded within the bridge deck, validating the effectiveness of the technology.

From the analysis results of data from an acceleration sensor at a single location on the surface of the bridge, Fujitsu confirmed that it is possible to estimate the degree of damage across a wide area of a bridge's interior using this technology. Additionally, detecting the occurrence of internal stress using this technology allows for the estimation of damage in its earliest stages, and can contribute to early countermeasures. Duplicating these tests in the future will make it possible to remotely estimate the degree of internal damage with a high degree of accuracy using surface-mounted sensors, enabling the enhancement of bridge maintenance and management tasks.'

NEW SENSOR IMPROVES EARTHQUAKE FORECASTING

Electronics Design Show exhibitor Omron has launched a new generation of "earthquake savvy" smart sensors that could greatly improve the automation of and advance warning provided by earthquake forecasting.

Traditional systems usually provide 60 to 90 seconds notice depending on the distance of the earthquake hypocentre, travel speed and distance between the primary P waves and secondary S waves, and the effectiveness of the relay technology used.

The Omron D7S Seismic Sensor can be installed directly on machinery, halting production lines and other potentially hazardous vibration when seismic vibration is detected, as well as being able to determine post-quake damage by mapping seismic intensity and providing information on the risk of building collapse.

The article 'Shaking up Earthquake Warning Systems' by James Hayes in *Engineering and Technology* Vol. 12 Issue 10 (November 2017) quotes Gabriele Fulco, Product Manager for Omron as follows:

"The D7S sensor has algorithm technology that gives high-precision measurement of spectral intensity, allowing the sensor to reject impulse vibration noise and respond only to genuine seismic activity. If a plant happens to be located next to a train line, the sensor uses its three-axis accelerometer and Omron's spectral intensity value calculation algorithms to distinguish between seismic activity and other movement."

Each D7S features an internal memory and I2C (inter-integrated circuit) interface enabling it to be integrated with IoT devices and smart meters, as well as bridges and flyovers.

Omron Corporation is based in Kyoto, Japan, and may be contacted on 07831 651 295.

MULTIPHYSICS SOFTWARE HELPS PREVENT ELECTRICAL ARCING IN SATELLITES

In 1995 Boeing Satellite Systems introduced a new family of communication satellite buses, the bodies that contain power, control and propulsion systems. These used a high-voltage bus connected to a 100V stabilised power source as opposed to the standard 27V. This introduced an increase in operating voltage that decreased operating currents and lowered the corresponding ohmic losses in the conductors, but it also introduced electrical arcing, a potentially catastrophic failure mode in the electronic systems of the satellite.

The article 'Seeking out Electrical Arcing Regions in Satellite Systems' by Gemma Church in *Comsol News* (2017) quotes Dr. Vasily Kozhevnikov, Researcher at The Institute of High Current Electronics in Tomsk, Russia, as follows:

"The transition to the new standard of operating voltages has led to the problem of an electric arc ignition between the elements of the electronic circuit boards. In order to keep the mass of the satellite as small as possible, the space inside the circuit housing is not filled with an insulator or built to hold a vacuum. But that allows electric arc discharge or discharge cascade that can potentially spread over a large volume of onboard equipment."

"The ignition of an electric arc inside the onboard satellite system always leads to partial or complete failure. In most cases it causes the termination of satellite use."

The article then continues to explain:

'To prevent the destruction of an onboard electronic device by a spontaneous electric arc, a so-called "critical region" must be identified, which is the area where self-sustained discharge ignition occurs. Once this potentially problematic area has been found, engineers need to conduct further investigations into what may trigger an electrical arc discharge.'

'Experimental studies fail to stand up to the challenge of identifying these electronic hotspots because they cannot reproduce the full range of operating parameters that exist in space orbit.'

Simulation, the only other realistic alternative, is, unfortunately, also problematic with a typical onboard electronic device consisting of multiple printed circuit boards distributed over a large area and enclosed within a metal casing.

The Tomsk-based research team sought a "decomposition" methodology implemented with computational tools:

'Instead of performing a complete direct current discharge simulation for the entire electronic device, they created a custom simulation app that would autonomously partition and analyse the device to find the most probable critical regions.'

For this purpose COMSOL Multiphysics® software was used, with its Application Builder tool applied to create a multiphysics model that would support the whole simulation process:

'An important modelling step was preprocessing, which was carried out to apply the proper boundary conditions and import the detailed geometry of the real on-board electronic system.'

'With the Application Builder, the team performed preprocessing using a custom 3D macromodel method. They also implemented their own import engine with automatic correction of object boundaries. The method consisted of both import and automatic correction of object boundaries functionalities. Without correction, these errors could have become serious obstacles in the simulation.'

After preprocessing, the modelling methodology consisted of three stages: preliminary electrostatic analysis of potential critical regions in a 3D model; extraction of field-enhancement areas and the definition of critical regions with associated 2D models; and DC-discharge simulation of critical regions to further investigate parameters of interest.'

In its conclusion the article again quotes Dr. Kozhevnikov:

"We have solved the problem of arcing diagnostics; nevertheless we expect that the voltage increase will also require serious redesign of certain on-board electronics to fit new operating conditions. Simply speaking, if the operation conditions of some device significantly differs from 'normal conditions', then you need to rebuild its architecture. Our app provides recommendations for the redesign of printed circuit boards in order to make them more arc resistant, but it could also be useful in designing fault-tolerant electronic systems."

Further Information

COMSOL was an exhibitor at The Electronics Design Show and may be contacted on 01223 451 580.
Email: info@uk.comsol.com

DRIVERLESS VANS DELIVER GROCERIES IN GREENWICH

Online supermarket Ocado, with the help of partner Oxbotica, a spin-out from Oxford University, has completed the UK's first trials of CargoPod, an autonomous delivery vehicle, in the London Borough of Greenwich.

The trials are part of the Greenwich Automated Transport Environment, or GATEway Project, led by The Transport Research Laboratory, which has already used autonomous pods to shuttle people around the Greenwich peninsula.

The article 'Autonomous Delivery' by Tom Austin-Morgan in the October 2017 issue of *Eureka!* Magazine explains more:

'CargoPod has been developed by Oxbotica and is guided by the company's Selenium autonomy software system, which uses two lidar sensors as well as several cameras to enable real-time accurate navigation, planning and perception in dynamic environments like busy residential areas. The CargoPod is run by the same software as the autonomous shuttles, meaning that it can predict the trajectory of people, cyclists and other vehicles that are moving around it. It is programmed to make emergency stops if someone were to step out in front of it, yield to other vehicles and follow people or cyclists at a perceived safe distance of around five metres.'

The article quotes Oxbotica's Chief Executive Dr. Graeme Smith as follows:

"We took a standard electric vehicle and modified it so we could drive it electronically. The compartment on the back swings open so you can load up to 128 kg of groceries using a forklift truck. Once the boxes are in there the customer will get a message on their phone to say which of the eight lockers on the side of the vehicle is theirs to open when it arrives."

Oxbotica is currently pioneering the laser mapping of environments where GPS has been found to be ineffective and overlooked by initiatives such as Google street mapping. On this Dr. Smith states:

"There are a lot of companies that are laser mapping all of the roads in the world, but when you get into a community like this or a campus community, maybe your own driveway, these are not things that anybody has ever mapped before."

The technology that we are introducing has to have the capability to form maps itself and then transmit those maps between other vehicles that might want to use the same area."

Oxbotica has recently been awarded a £13 million Government sponsored project called 'Driven', which will soon see six autonomous vehicles operating between London and Oxford.

INTERNET RETAILING AND eDELIVERY

This twin conference and associated exhibition took place at The Novotel West London on 5th. October.

Internet Retailing is now in its twelfth year, but as there is no eCommerce without delivery the previously separate eDelivery Conference has been colocated with it.

The organisers, Clarion Events, State:

'IRC and EDC 2017 will shake the industry and question well established retail concepts, equipping digital leaders with a platform to learn, network and continue developing their digital retail and multichannel strategies.'

The conference was divided into four tracks under the headings of 'Analyse and Conquer', 'Adapt and Expand', 'Create and Innovate', and 'Stand up and Deliver', and featured a total of 25 presentations. Topics included 'Emotional eCommerce', 'Reforming Digital Retail to complement the modern Informed Customer', 'How to develop Digital Agility in order to structure and accelerate International Business', 'OK Google - what's the Future for Retail?', 'How Fashion Retailer PrettyLittleThing used Technology to increase Sales', and 'Building In-house Teams of Technology Experts to carry your Organisation into the Future'.

These presentations were augmented with around 30 workshops and roundtables, which included 'Providing a richer Digital In-store Customer Experience with Barcode Scanning and Augmented Reality', 'Conversion in Mobile: Payment Innovation to boost Growth and remove Friction', 'Machine Learning Software: Beyond the Hype - How to buy it and apply it', 'Using Offline and Online Data in Retail Facebook Marketing', 'How Behavioural Data is redefining Email Personalisation', and 'Closing the Mobile Conversion Gap with an App'.

Below is a review of some of the highlights and popular topics.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN THE RETAIL ENVIRONMENT

One of the hottest topics currently in eCommerce is the application of artificial intelligence and machine learning.

IRC Sponsor Monetate® is very much at the forefront of this pioneering field, using the industry's first Experience Marketing Platform that combines marketer creativity with predictive models and machine learning to optimise each moment of interaction. At Cyber Week 2015 Monetate® notably influenced over a third of all US eCommerce sales, and has more clients in the IR500 than any other company.

In the *Retail Week* Connect Report 'Personalisation Exposed' (September 2017), published in association with Monetate®, a chapter is presented entitled 'Understanding Machine Learning', which introduces the subject of AI and Machine Learning in the retail environment.

The chapter quotes Mark Zuckerberg, Chief Executive of Facebook, who stated in 2016 that "the biggest thing that we're focused on with artificial intelligence is building computer services that have better perception than people", and picks up on his prediction that in the next five to ten years computer systems will have become better than people at basic human senses, such as seeing, hearing and language.

The recent survey by Retail Week and Monetate® is then highlighted, indicating that currently around 9 per cent of retailers are investing in machine learning based personalisation, with 17 per cent in the process of starting investment and a further 16 per cent set to commence in 2018.

The article states:

'There is a 50/50 split between those that are familiar with machine learning and AI and those that are not, illustrating why the industry is still divided in its take up.'

There is certainly a gap in knowledge when it comes to machine learning, with 33 per cent of respondents somewhat knowledgeable about it, and 26 per cent saying that they are not particularly knowledgeable. Some 10 per cent only know the basics and 21 per cent admit they do not know anything about it.'

It is clearly still early days for AI and machine learning in the retail sector, and cost and proof of value are highlighted as barriers to investment, but recent innovations such as Monetate's Intelligent Personalisation Engine machine learning product, and early successes from the likes of fashion retailer JD Williams, which decreased its bounce rate by 3.3 per cent in just one week after deploying Monetate's machine learning capabilities, could be set to change some of these perceptions.

With personalisation being increasingly linked to the benefits of implementing machine learning technology it is noted that it is increasingly the IT department that is delegated the responsibility for its development.

The article states:

'Some 31 per cent of retailers say the IT team is responsible for machine learning strategy, compared with 27 per cent and 14 per cent who say marketing and ecommerce respectively.'

In its conclusion the article quotes Founder and Executive Chairman of Monetate® David Brussin, who is keen to dispel some of the myths surrounding AI and machine learning in retail:

"Machines are not going to create experiences out of whole cloth. AI can allow marketers to scale in ways they can't otherwise. It effectively allows marketers to do things that were beyond their reach before.

It is the human and tech being able to achieve things that neither could do on their own - not about a robot that can do it all."

Rise of the Machines

In the IRUK Top 500 Dimension Report '*Strategy and Innovation*' (September 2017), by InternetRetailing in partnership with Barclaycard, Paul Skeldon, Mobile Editor for InternetRetailing, in his article with the above title, highlights customer service as 'the first place that AI is making its mark'.

He notes particularly the increasing role of chatbots, which are effectively automated text-chatting machines. He states:

'Customers become frustrated and feel disconnected when they get placed in a telephone queue or loop when trying to reach the customer service desk. This problem no longer exists with a chatbot. The virtual contact can be reached around the clock, from anywhere without the customer having to wait to call in office hours. In addition to this, with more customers increasingly using mobile devices to inform, communicate or buy, they are very familiar with using a chat format.'

AI and machine learning do, however, have the prospect of going much further. The author continues:

'Imagine being able to use machine learning that can take in and analyse all the data the business has across your whole company - every detail and snippet about every consumer. This is the promise of the next generation of AI for retailers.'

'With consumers throwing off vast amounts of data as they go about their daily lives, brands and retailers face a dilemma: they need to use such data as to personalise how they interact with consumers, but without the power of AI they can't do anything with it.'

The article highlights research by Forrester that emphasises the role of AI in developing real-time interactions with consumers across multiple channels:

'Some 72 per cent of retailers questioned by Forrester in the US plan to use AI to start to offer such interaction between consumer and brand in the coming twelve months.'

In looking to the future the author points to the building of data-driven, voice-recognising robots that can answer questions, deliver advice and upsell to consumers as 'the next stage of the evolution of ecommerce'.

He foresees a period of about five years for AI to be embedded as standard across IT systems.

In the InternetRetailing Whitepaper '*Driving Forces*' (September 2017) Chloe Rigby, in her article, also entitled 'Rise of the Machines', highlights yet another survey, this time an IMRG Benchmark Study that found that 52 per cent of fashion retailers were planning significant investment in AI in the coming year, with a further 19 per cent planning to do so in the following year. Fewer than a third had no plans to use AI at all in merchandising.

This article also explains how a number of companies are now using AI and machine learning. Technology pioneer and online grocer Ocado, for example, is now using AI in its call centre to enable staff to handle customer enquiries:

'Machine learning is used to sort and prioritise messages for human staff to deal with. The retailer has said that its aim is not to take away jobs from humans but rather to ensure the jobs its staff do are the more interesting ones, in this case removing the need to manually sort through communications so that call centre staff can focus instead on problem solving.'

Other examples presented by Ms. Rigby include online department store Shop Direct, which has introduced a virtual assistant chatbot to its fashion brand Very's mobile app, which uses machine learning to answer shoppers' questions around orders for payments.

Amazon is also cited for its recent work with the Civil Aviation Authority to develop drones to deliver lightweight goods over short distances.

Further Information

Copies of the reports may be obtained from www.internetretailing.net/IREU

Monetate® may be contacted on 020 3750 0376. Email: jcattermull@monetate.com

CASE STUDY: OTTO GROUP

In the IREU Top 500 Dimension Report 'Operations and Logistics' (June 2017) in her article 'AI in the Real World', the same author presents the case study of Germany's second largest online retailer, Otto Group, which sells diverse products from furniture to electronics and fashion items. It offers 2.2 million items from 6,000 brands on its website and has used machine learning effectively to reduce the time that customers had to wait for orders from seven days to just one or two.

The article describes how technology from Blue Yonder analyses around 3 billion transactions, including past sales, prices and stock levels in order to forecast customer demand and make automated decisions about which goods to order and in what sizes and colours:

'By the end of 2016 Otto Group, which also includes retail brands such as Bon Prix, was feeding it with more than 300 million data sets a week - with around 200 factors taken into account for each item. That produces more than 5 billion forecasts a year. It's now at a scale that human decision-making could not hope to replicate.'

Author Chloe Rigby quotes Director of Marketing at Blue Yonder, Dunja Riehemann, as follows:

"Machines are always better when they have millions of decisions to take on a daily basis. Humans can no longer take operational decisions on what needs to be done daily, with all the articles, different sizes and colours that are involved. Machines can make decisions much more precisely."

Also quoted is Frank Surholt, Head of Otto's Corporate Public Relations. He says:

"One of the factors that the software recognises is the weather and the weather forecast. The software knows it's going to rain tomorrow in Hamburg, and calculates that a lot of people in that area will order waterproof jackets and shoes tomorrow."

The dream could be that we know, in cooperation with Blue Yonder, that tomorrow at 3pm in Hamburg someone will order a refrigerator from Bosch. We don't know who will order this, but we know someone will. This means that we are able to deliver this refrigerator to the local warehouse, even as we are waiting for the customer to order. Knowing where a customer will order which product will mean we are much faster. That's the vision for the future."

It is noted that with this kind of automated decision-making, overstocking 'has become a thing of the past':

'It now often happens that goods that are bought using automated decisions never go into storage, but are sent directly to the customer.'

In the UK Morrison's is also noted to be investing in the technology:

'Morrison's recently adopted the Blue Yonder technology to optimise replenishment and automate orders for 26,000 ambient and long-life product lines in its 491 stores. So far, it is reducing gaps on its supermarket shelves, as it automates 13 million ordering decisions a day.'

EMOTIONAL ECOMMERCE

This presentation, in the 'Analyse and Conquer' conference stream, was presented by Lauren Wolfe, Marketing Manager for IRC Sponsor Klarna, the leading European alternative payment provider based in Stockholm and founded in 2005.

Klarna allows the consumer to receive the goods first and pay afterwards, whilst assuming the credit and fraud risks for the merchants. The company currently serves 45 million customers, works with 65,000 merchants and is active in 18 markets. It has 1,400 employees and is noted for its fast growth.

In her presentation Ms. Wolfe argued that frequently transactions are cancelled due to emotions that are triggered by factors such as fear of entering personal details, frustration or poor shipping. There were, she said, two types of ecommerce, the logical and the emotional, the latter being driven by feelings and impulse, with mobile browsing noted particularly for its ability to generate spontaneous purchases.

In an attempt to try to understand why over half of all online transactions are abandoned before completion Klarna commissioned The University of Reading to undertake research to examine the psychological and emotional factors that cause this behaviour.

The presentation focused on the report 'Emotional eCommerce: Ups and downs on the online Experience' published by The University of Reading in July 2017, which looked at what consumers love and hate about online shopping and revealed new conclusions as to how retailers can improve the online journey in order to improve online completion rates, enhance the online shopping experience and encourage successful sales.

Studies showed that the most common reasons for cancelling a transaction were:

- * Having to register for an account (33 per cent)
- * Fees for alternative payment methods (25 per cent)
- * Lack of trust in site security (23 per cent)
- * Slow checkout processing (27 per cent)
- * High shipping costs (27 per cent)
- * Concerns over entering details on public WiFi (15 per cent)

The report highlights the 'emotional baggage' that often leads to hesitation - a key factor in predicting online shopping cart abandonment, especially at the final payment stage.

Personal and financial fears, it is said, 'can supersede concerns over products and services', whilst the fear of transaction risk 'tends to increase with transaction size', and concerns over trust of the online merchant 'plays an important mediating role in subduing risk'. Website navigation can also 'significantly impact consumer irritation'.

The report states:

'Don't underestimate how hard it is for some shoppers to deal with the complex, cognitive processes involved in ordering online. Faced with global choice, countless decisions and, of course the man-machine interface - the physical "experience" can make or break a sale.'

Transaction inconvenience is noted to be 'the largest predictor of transaction abandonment' fuelled by the requirement to enter large quantities of personal information and 'technical glitches' that slow the process or lead to repeated data entry.

The less the customer is required to think about inputting data, the more likely they are to make a purchase, and a website's vividness and social presence 'can enhance impulsive purchases'.

With this backdrop the report presents 21 ways to create more emotionally intelligent online strategies. These include:

- (i) Encourage shoppers to develop 'mShopping' habits by providing easy-to-use platforms that stimulate their emotional response.
- (ii) Collect information to tailor the website experience to the consumer, product and device.
- (iii) Embed 'one touch pause' functionality into the online shopping experience to allow customers to return to the same place.

(iv) Ensure fluency so that the transition to the checkout page does not cause an emotional purchase to switch to a logical one.

(v) Facilitate 'one click' purchasing to shorten the checkout procedure.

(vi) Introduce design measures that promote website loyalty.

(vii) Ensure security information for websites and apps reflect consumers' different cognitive states.

The report then provides a 'map' depicting a psychological model showing the various emotional stages of online payment from cart to checkout, with 'sales nudges' derived from the recommendations presented.

Klarna may be contacted on 020 3005 0820. Email: sales@klarna.co.uk

CASE STUDY: PRETTYLITTLETHING

The presentation 'How Fast Fashion Retailer PrettyLittleThing used Technology to increase Sales', in the 'Create and Innovate conference track, was given jointly by James McDougall, IT Director for PrettyLittleThing.com, and Katie Woodhead, Head of Business Consulting for IRC Sponsors ATTRAQT, a specialist in online merchandising and ecommerce personalisation.

PrettyLittleThing was founded five years ago and is primarily focused on the 16 to 24-year-old age range. The company has experienced rapid growth with upwards of a million followers on Facebook, who are keen users of social media, spending an average of two hours a day on it. These customers, however, are continually changing the way they interact. Some 70 per cent of shopping comes from mobile, and the conversion rate is 6.2 per cent.

The company frequently experiences loads and spikes in traffic, particularly following celebrity endorsements, and it therefore needed a platform that could handle this:

"PrettyLittleThing needed a platform that enabled automation to take care of the heavy lifting., while giving its in-house merchandisers the freedom to manually curate pages as required. On top of this, the technology would have to cope with the demands of managing multiple overseas websites. To achieve this PrettyLittleThing partnered with ATTRAQT.

By integrating ATTRAQT Fredhopper's search and merchandising platform, PrettyLittleThing are able to automate the long tail, while closely controlling the presentation of key products on a granular level. This is done through using agile 'visual search' merchandising capabilities. The set-up process involves an intuitive drag-and-drop mechanic, allowing easy access to any item in a category while the team is building a page, plus advanced item grouping functionality to introduce automation to its merchandising processes. As a result PrettyLittleThing is able to keep on top of trends and its site fresh and interesting for frequent customers."

Navigation was noted as being the most popular method for users to find what they want, but the search function also needs to exceed customer expectations. ATTRAQT Fredhopper's search functionality therefore processes all search terms for PrettyLittleThing, dispensing with any excess that comes from natural language, such as pluralisation, special characters and stop words:

"PrettyLittleThing's customers can sometimes be eager to search a term and overlook specifically merchandised pages that are more naturally accessible through navigation. For example, PrettyLittleThing's website has a lot of banners, item ordering information and text for sub-categories such as accessories or dress types, and while a search would bring relevant items to the customer, they would miss out on this extra information and merchandising effort. To solve this, PrettyLittleThing is using ATTRAQT Fredhopper's redirect strategies to convert specific search terms to category page URLs, creating a frictionless shopping experience for the customer."

ATTRAQT Fredhopper's multilingual cloud technology has enabled PrettyLittleThing to standardise implementation architecture across global websites, while independently managing multiple sites and seasonal merchandising strategies. With any other merchandising platform managing this information would have been "overwhelming", but with ATTRAQT Fredhopper everything is managed by a single interface and single catalogue data input.

Results for PrettyLittleThing have notably included an 8 per cent uplift in order value and a 7 per cent increase in conversion rates in just four months.

Mr. McDougall concluded:

"Our global operation has many complexities and Fredhopper's technology is able to cope with these demands. Search functionality has improved considerably, while merchandisers working on international sites now have the freedom to style a page as they wish, based on seasonality. These improvements, together with an overall increase in performance of our sites have contributed to the recent uplifts in order value and conversion."

Further Information

ATTRAQT provides visual merchandising and search services to online retailers through a cloud based SaaS platform. It was launched in 2003, evolving from search technology company Locayta. Its two distinct products, Freestyle Merchandising and Fredhopper are easily managed without the need for extensive IT support and offer a highly configurable, real-time platform that drives conversion. They may be contacted on 020 3675 7800. Email: sayhello@attraqt.com

CUSTOMER DATA PLATFORMS

A Customer Data Platform may be defined as "an integrated database managed by marketers that unifies a company's customer data from online and offline channels to enable modelling and to drive customer experience". It is a relatively recent concept, as distinct from the related customer relationship management (CRM) and data management platforms (DMPs) concepts, which are noted for their weaknesses of fragmented data silos, incompatible systems in different departments and lack of much needed tools to manipulate the data they contain with the flexibility and agility that is required to create a real-time view of the customer.

In order to present a case for the adoption of Customer Data Platforms, InternetRetailing, in conjunction with RedEye, have published a Whitepaper with the above title that explains the concept in more detail and provides advice on how to implement a CDP strategy.

Matthew Kelleher, Chief Commercial Officer for RedEye states the following in his Sponsor's Introduction:

"Since the advent of the first catalogues and direct marketing, the goal for success was accurate data. But as the internet expanded, the number of potential customer touchpoints has mushroomed. And, unfortunately, data management platforms and solutions have simply not kept pace.

The last couple of years have seen a litany of reports and research that highlight one of the key issues for marketers is not only access to data, but the quality of that data. Without access to quality data, a variety of applications - Campaign Management, Analytics or Business Information - do not reach their potential value. An effective multi-channel single customer view is key to the success of future marketing endeavours.

Increasing levels of automation and integration means that the high charges for manual database builds are increasingly a thing of the past. To create an effective single customer view is now vastly more cost effective, both in terms of setup and ongoing charges."

Paul Skeldon, Mobile Editor for InternetRetailing then adds in his introduction:

"CDP is going to underpin Artificial Intelligence (AI) and machine learning driven marketing systems that are poised to sweep through retail marketing departments in the next 12 to 24 months. The data and understanding that both AI and machine learning create will need to be curated and managed in new and more effective ways and CDP holds the key.

All retail businesses need to move to marketing that is personalised and driven by the needs and habits of individuals - and that requires technology to gather data and understand data on a scale never before seen. That is where AI and machine learning come in. But without data, these futuristic marketing technologies are useless: you need a CDP strategy first and foremost to gather data, store data and make sense of data before you can apply more technology to being truly innovative with that data."

In describing the components of a CDP, the paper refers to it as ' a technology platform that can pull together the data you have and help the company work out how best to use it across the marketing channels at its disposal'. It then lists the factors that need to be considered when assessing third party CDP providers, namely:

- * Data connections (how it manages and mines data and matches it to existing channels)
- * Data processing capabilities (ability to handle both batch and streaming data processing in near real-time)
- * Segmentation capabilities (ability to segment customer data and show what sorts of persistent customer profiles it can create and maintain)
- * Outbound channel support
- * Ability to plug easily into other best of breed platforms (agnostic versus integrated)
- * Operation
- * Analytics (ability to analyse and quantify what the CDP is delivering)

In presenting the business case for CDP the paper highlights the advantages of better use of multiple channels, better device conversion, and improved analytics and business intelligence:

'In the multichannel world that retailers now live in, finding the right channel for the right customer at the right time is an increasing business driver. No longer can a retailer just look at online versus in-store, instead it has to be assessed as to where in the online, mobile and real world each customer is doing what part of the retail journey for any given purchase. CDPs can not only collect and collate this data, but can also deliver indications as to how best to contact customers through the channels you have available. This can reduce duplicate efforts, as well as removing the annoyance factor of customers being emailed and texted and DM-ed all at once. This is not only a vast efficiency gain for the retailer, but also leads to happier customers with the inherent loyalty and reduced churn that go with that.'

RedEye provides a unique solution called Contour, which is driven by a database that combines all customer data online and offline. They may be contacted on 020 7730 9958.

NEW STANDARD FOR PIN-BASED PAYMENTS

The major payment networks have produced a new security standard for PIN-based payments using smartphones, which has the potential to remove the need for point-of-sale (POS) terminals at merchants.

The new standard requires software to be installed on smartphones such that payments could be made without the need to link to external hardware such as a terminal or plug-in card reader.

The Payment Card Industry Security Standards Council (PCI SSC), which is operated by Visa, Mastercard, American Express, Discover and JCB, has held discussions with industry stakeholders about codifying PIN acceptance for payments in software for mobile devices. The new standard focuses on software-based PIN entry on commercial off-the-shelf (COTS) devices such as consumer-grade mobile phones and tablets, and is in addition to other PCI Security Standards that already apply to 'PIN-on-glass' i.e. PIN entry via a touchscreen technology, by addressing 'glass' devices such as tablets and touchscreen-based devices that are dedicated for mobile payment acceptance.

In *Card and Payments World* (July 2017) in the article 'Is this the End for POS Terminals?' PCI SSC Chief Technology Officer Troy Leach is quoted as follows:

"There are numerous devices validated against the PIN Transaction Security Point-of-Interaction (PTS POI) standard that provide a secure capability for PIN entry either directly on a dedicated device, for use of PIN-entry, or through a peripheral device that could be physically or wirelessly attached to a COTS device.

The key difference is software for PIN-entry. This new standard will provide manufacturers a software-based approach for protecting PIN-entry on the wide variety of COTS devices on the market today.

The PCI PTS POI standard will continue to apply to solutions relying upon protections provided by dedicated hardware and its operating system.

In developing this new standard, we will draw from lessons learned from years of doing PIN-entry security through hardware and also the mobile device evaluations against the PCI PTS POI standard."

The article adds:

'Some of the specific areas the PCI SSC is exploring include: isolation of the PIN from other cardholder data; dedicated hardware for payment card entry (PTS approved secure card readers); software security for mobile applications; and robust remote monitoring of the COTS device.'

