HUMAN ROBOT INTERACTION

A blueprint for Human Robot Interaction (HRI) aims to accelerate the safe and ethical development of robotics that people can trust.
COMMENT
Risk-averse cultures, excessive red tape and time constraints are helping to restrict innovation

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Study uncovers way to encode computational information without using an electrical current
How can UK electronics distributors address Brexit and other challenges in 2020?
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Innovative sensor capabilities are creating new possibilities for identifying, managing and treating illness. By Charlotte Hathway

MISSION STATEMENT
‘New Electronics keeps designers and managers abreast of the latest developments in the world’s fastest moving industry’
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Research carried out by Studio Graphene among 750 senior decision-makers within UK organisations has discovered that risk-averse cultures, excessive red tape and time constraints are helping to restrict innovation within larger businesses.

The survey found that 71% of organisations have budgets and resources dedicated to innovation, rising to 86% among large businesses (those with over 250 employees) and a large majority of those questioned actually have a team or department that’s dedicated to innovation, with three quarters (75%) meeting more than once a month to discuss potential areas to creatively improve.

So why do companies feel that they are struggling when it comes to being innovative?

Innovation is seen as a priority for many organisations, but most believe that they are struggling to become more innovative. Half of those questioned for this survey consider their rivals to be more innovative than they are.

Most of those questioned said that there are too many steps involved in getting management to give the go ahead for new ideas and too many organisations are risk-averse, when it comes to embracing new innovative technologies. Even among those that have looked to implement a new technology in the past 12 months, a third said that they had tried and failed – with many pointing to Brexit as hampering innovation in their organisation.

According to Ritam Gandhi, Founder and Director of Studio Graphene, “Innovation is one of the most used buzzwords in business – that’s because almost every organisation is, essentially, seeking new ways to improve what they do and how they do it. Unfortunately for large businesses, our research shows they are facing more pronounced challenges in their pursuit of innovation.”

So, what to do?

Well it might be all well and good having budgets and personnel dedicated to innovation but, according to this research, if the processes for creating and implementing new ideas are not in place then employees’ creative thinking is likely to get lost in a web of red tape and end up simply being rejected by risk-averse managers!

Neil Tyler, Editor (neil.tyler@markallengroup.com)
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Imagination launches IMG A-Series

IMAGINATION UNVEILS THE TENTH GENERATION OF ITS POWERVR GRAPHICS ARCHITECTURE. NEIL TYLER REPORTS

Imagination Technologies has launched what it claims is the fastest GPU IP to date. The IMG A-Series evolves the company’s PowerVR GPU architecture to address the graphics and compute needs of next-generation devices across multiple markets.

The IMG A-Series provides a multi-dimensional approach to performance scalability which ranges from 1 pixel per clock (PPC) parts, for the entry-level market, right up to 2 TFLOP cores for performance devices, and beyond that to multi-core solutions for cloud applications.

Dr. Ron Black, CEO, Imagination Technologies, said: “IMG A-Series is our most important GPU launch since we delivered the first mobile PowerVR GPU 15 years ago. It offers the best performance over sustained time periods and at low power budgets across all markets.”

The IMG A-Series has been designed to deliver significant improvements, at the same clock and process, offering 2.5x the performance, 8x faster machine learning processing and 60% lower power than current PowerVR devices. It is available in four high-performance configurations and is already licensed for multiple markets. The first SoC devices are expected in 2020.

The series also features Imagination’s HyperLane technology in which individual hardware control lanes, isolated in memory, enable different tasks to be submitted to the GPU simultaneously for secure GPU multitasking. Using Dynamic Performance Control, the GPU can spread its performance across these multiple tasks, executing them all, while maximising GPU utilisation.

Another feature, AI Synergy, enables SoC designers to use the compute capability in the series to accelerate AI workloads. The GPU delivers graphics performance, while using its spare resource to enable programmable AI alongside a fixed-function, highly-optimised neural network accelerator.

IAR Systems updates RISC-V development tools

IAR Systems has announced a new version of the toolchain IAR Embedded Workbench for RISC-V. Version 1.20 adds support for the base instruction set RV32E and also the standard extension for Atomic operations (A).

RISC-V provides vendors, with the flexibility to design custom cores with the exact definitions needed for the application or product. Through optimisation technology, the Embedded Workbench helps developers ensure their applications fit the required needs and optimises the utilisation of on-board memory.

Version 1.20 adds support for the base instruction set RV32E that targets smaller embedded devices with the register set reduced to half of what is available in RV32I. The standard extension for ‘A’ operations adds instructions that support atomic read, modify, and write actions to support synchronisation between different HW processes that access the same memory.

“The more features we add, the more designers can benefit from fully utilising the quality, reliability and performance that distinguish our complete IDE,” commented Anders Holmberg, Chief Strategy Officer, IAR Systems.

Aldec’s Active-HDL Verification capabilities enhanced

Aldec has enhanced the verification capabilities of Active-HDL, its Windows-based Integrated Development Environment (IDE) for FPGA design creation and simulation.

Enhancements include the ability to compile and simulate SystemVerilog verification constructs, which in turn makes Active-HDL suitable for use in UVM test environments, and for functional coverage and constrained randomisation simulations. In addition, a 64-bit simulation capability has been added by default to selected popular configurations, along with enhancements to Active-HDL’s block diagram and state machine editors.

“These features add to the development environment’s capabilities,” said Louie De Luna, Director of Marketing. “We first supported the methodology with our high-end mixed HDL simulator Riviera-PRO, and Active-HDL IDE now supports the latest UVM library as IEEE 1800.2-2017, making life easier for our users wishing to run third party VIP. In addition to supporting native SystemVerilog verification constructs, VHDL packages can be compiled and used as SystemVerilog packages in the simulator.”

Active-HDL’s Installshield program has also been enhanced, and supports 4k screens, plus the tool’s GUI has received a makeover.
MediaTek unveils Dimensity

MediaTek has launched Dimensity, a family of 5G system-on-chips (SoCs) intended to provide improved levels of connectivity, multimedia, AI and imaging for smartphones. The Dimensity 1000 is MediaTek’s first 5G mobile SoC in its 5G family of new chipsets. The 7nm single chip solution comes with an integrated 5G modem.

“Our Dimensity series is a culmination of MediaTek’s investment in 5G and positions us as a leader driving 5G development and innovation. Our 5G technology goes head-to-head with anyone in the industry,” said MediaTek President Joe Chen.

The first Dimensity powered devices will come to market in the first quarter of 2020. The series integrates MediaTek’s 5G modem in one design, delivering significant power savings compared to competing solutions, according to Chen.

Dimensity supports 5G two carrier aggregation (2CC CA) and MediaTek claims that it is the world’s fastest throughput SoC with 4.7Gbps downlink and 2.5Gbps uplink speeds over sub-6GHz networks.

The chipset is designed to support stand-alone and non-standalone (SA/NSA) sub-6GHz networks and includes multi-mode support for every cellular connectivity generation from 2G to 5G.

It also integrates the latest Wi-Fi 6 and Bluetooth 5.1+ standards for the fastest and most efficient local wireless connectivity, offering more than 1Gbps throughput in both downlink and uplink speeds.

Dimensity pairs four Arm Cortex-A77 cores operating up to 2.6GHz with four power-efficient Arm Cortex-A55 cores operating at up to 2.0GHz.

The device comes with a new MediaTek AI Processing Unit – APU 3.0 – with more than double the performance of the company’s previous generation of APUs.

Researchers find solution to overheating mobile phones

STUDY UNCOVERS WAY TO ENCODE COMPUTATIONAL INFORMATION WITHOUT USING ELECTRICAL CURRENT. REPORTS CHARLOTTE HATHWAY

Researchers at the National University of Singapore have uncovered a way to encode computational information without using electrical current which could lead to faster technological devices that can use energy without overheating.

“We always encounter such problems and inconveniences when using our devices. We often are becoming ‘hot’ and ‘slow’, moreover, we need to charge them frequently and have to bring another portable charger sometimes,” explained Professor Yang Hyunsoo, the team leader of this research.

Traditional electronic chips suffer from substantial ‘joule heat’, which occurs due to the flow of an electric current producing high temperatures. This is caused by rapid motion and frequent collision among moving charges inside the devices.

Rather than adopting standard electron injection methods used in traditional electronics, the researchers used ‘spin waves’ to switch magnetisation. Spin waves are propagating disturbances in the ordering of magnetic materials, and from the quasiparticle point of view, spin waves are known as ‘magnons’.

The team built a bilayer system consisting of an antiferromagnetic magnon transport channel and a topological insulator spin source. They then demonstrated spin wave driven magnetisation switching in the adjacent ferromagnetic layer with a high efficiency at room temperature.

This shows a switching scheme based on spin waves can avoid moving charges, reducing joule heat and power dissipation. The researchers say spin wave-based switching could open a new avenue for energy-efficient chips.

In addition, the operation frequency of spin waves is in the terahertz range, and devices using this range can transmit data at significantly high speeds. Prof Yang added, “Magnon torque-based devices will allow the implementation of ultrahigh speed applications in the future.”

Harwin Academy students provided with robotic technology

Harwin is continuing to invest in and support the further promotion of science, technology, engineering and mathematics (STEM) to younger generations.

To ensure that students attending Havant & South Downs College (HSDC) have access to the hardware necessary to support their ongoing education, the company is donating a state-of-the-art robot arm – a package worth more than £30,000.

In September 2018, in association with HSDC, the company established the Harwin Academy with the aim of offering school leavers a more effective route into the engineering profession. After completing the two-year course, students receive an internationally recognised qualification, plus the option to then join Harwin’s well regarded apprentice scheme.

The robot arm that Harwin Academy students will be working with is an RV-FR from Mitsubishi Electric. With a 504mm maximum reach radius, this highly dynamic servo motor-driven articulated unit supports motion across 6 axes. Incorporation of absolute encoder technology allows for accurate positioning and the highest degree of operational repeatability. This robot arm is predominantly intended for tasks like the inspection and assembly of small component parts. Weighing 3kg, it is easy to transport between different classrooms on the HSDC campus.

“I believe Britain’s future place in the world depends on our ability to advance our skills in robotics and artificial intelligence. It is critical that current engineering students are trained in computer coding and robotics to meet the future challenges that are facing this country,” said Harwin Chairman, Damon de Laszlo, during the presentation ceremony.
Cadence to acquire AWR from National Instruments

Cadence Design Systems has entered into an agreement to acquire AWR Corporation, a wholly owned subsidiary of National Instruments (NI).

AWR is an industry leader in high-frequency RF EDA software technology and, according to Cadence, will bring a highly talented RF team to the company. Cadence and NI have also entered into a strategic alliance agreement to expand their relationship to enhance electronic system innovation with a focus on communications.

AWR software is used by microwave and RF engineers to design wireless products for complex, high-frequency RF applications. The technology looks to accelerate the design and product development cycle of systems used in communications, aerospace and defence, semiconductor, computer, and consumer electronics, by helping reduce the time it takes to go from concept to manufacturing.

Under the terms of the agreement, Cadence will pay approximately $160 million for AWR and expects approximately 110 AWR employees to join Cadence.

OKdo adds Jetson Nano Dev Kit to its range

OKdo, part of Electrocomponents, has announced that it is adding the NVIDIA Jetson Nano Developer Kit to its range.

The Jetson Nano Developer Kit comes with out-of-the-box support for full desktop Linux, is compatible with many peripherals and includes accessories, ready-to-use projects and tutorials to help makers get started. The platform looks to bring artificial intelligence (AI) applications within the reach of makers, inventors, designers and engineers.

The Jetson Nano is an AI dev kit offering high-performance and power-efficient computing. It features NVIDIA’s JetPack SDK, which is built on CUDA-X and is a complete AI software stack with accelerated libraries for deep learning, computer vision, computer graphics and multimedia processing to support the Jetson Nano.

The platform delivers 472 Gflops of computing performance, consuming as little as 5W, making it suitable for object detection, video search and facial recognition.

Through the looking glass

HOW CAN UK ELECTRONICS DISTRIBUTORS ADDRESS BREXIT AND OTHER CHALLENGES IN 2020. BY NEIL TYLER

The electronic components market has been growing steadily over the past year and this trend is set to continue in 2020 and beyond, according to Jezel Hardern, Managing Director, Rutronik UK & Ireland.

“The UK market is no exception, which is of course good news for distributors. The bad news is that, with key components such as MLCCs still in high demand, distributors in the UK and elsewhere are likely to continue facing major challenges, especially shortages.”

According to Hardern, rising demand from the automotive industry, ever-evolving smartphones and the Internet of Things are some of the leading causes of the current shortages in components. And, with the rollout of 5G and the need for compatible end devices and new network infrastructure, the situation is likely to get worse.

“One reason for this is the high demand for components in Asia, which is affecting supply in significantly smaller markets such as Europe,” Hardern said.

“To address this, all the major manufacturers of components are already expanding their production capacities, but this strategy is unlikely to have an immediate effect on the wider electronics supply chain. That is why advanced planning and stock management optimisation remain so critical when it comes to distribution.”

Another inescapable challenge for UK distributors looms ahead: Brexit.

“Depending on how the UK’s withdrawal from the EU eventually pans out, key markets for the electronics industry are at risk of being hit hard. With thousands of jobs already being lost across the automotive supply chain combined with shrinking sales and production, it is easy to understand why some UK electronics distributors are starting to feel concerned. Luckily, recent research has shown Brexit presents the automotive industry with opportunities as well.”

“The failing value of the pound, for example, may encourage some UK car manufacturers to reshore production. This may act as an important economic stimulus that could ultimately benefit suppliers of electronic components. We’re also seeing a shift towards electrification and connected and autonomous (driver-less) cars.”

This year, for example, Jaguar Land Rover invested £1bn in the development of electric vehicles while the new electric Mini is now set to be manufactured in the UK, along with other electric cars.

“Growing investment in e-mobility may offset some of the negative consequences of Brexit, offering the electronics industry new opportunities for growth,” Hardern suggested.

“One area that is looking particularly promising for distributors of electronic components is the automotive industry’s ongoing migration from low-cost brushed DC motors to the more efficient brushless DC motors (BLDCs). BLDCs are smaller, lighter and offer a better power-to-weight ratio, with a wider dynamic response and improved torque. As such, they are key to reducing the total cost of ownership. BLDCs requires more complex drive solutions than brushless DC motors so electronic components including power management, gate drivers, MOSFETs, IGBTs and Hall effect sensors are becoming more critical than ever.

“Battery management is another key target many electronics distributors have set their eyes on. Lithium (Li) ion batteries, widely used in electric and hybrid vehicles, offer considerably higher energy density and voltage, with smaller dimensions, more charge cycles and a longer service life. This is where electronic solutions such as Battery Management Systems (BMSs) come in. A BMS guarantees the functional safety of the battery, prevents lasting damage and ensures optimum utilisation and a long battery life.

“The challenges UK distributors are up against are undeniable. But there are also good reasons to believe that, irrespective of the outcomes of Brexit, 2020 may also bring new opportunities for growth and development,” she concluded.
Scalable and sustainable IoT

CONFERENCE ATTENDEES DISCUSSED AI, SECURITY AND LIFECYCLE MANAGEMENT. CHARLOTTE HATHWAY REPORTS

Connected devices are flooding into our homes and our workplaces, yet embedded engineers still need to reach a consensus on how these should be maintained. That’s why this year’s Hitex Arm User Conference focused on building a scalable and sustainable Internet of Things (IoT) ecosystem.

Peterson Quadros, Product Manager for Functional Safety at Arm, opened the event with a look at practical steps for developing IoT endpoints. He explained that application development for secure IoT endpoints can become “as easy as classic embedded systems programming”. This can be done through adopting a new approach that balances three core priorities: managing device hardware configuration, software components, and system validation.

Next, there was a session on how to securely deploy, connect and maintain devices. Mathew Ockerse, Field Applications Engineer at Arm, explained that the core issue with IoT devices is that updating them is too difficult. Users do not always know if they need to use a micro USB, unscrew a back panel, or connect the device over a Linux-based computer, for example. For that reason, he said, “we need to have a fool-proof, standardised way to communicate with the devices so if there is a known issue it can be updated as quickly as possible to minimise the attack surface”.

Dealing with this security issue, Ockerse added, will also help address other device life cycle issues, such as deregistering so devices can be resold. If IoT devices are managed within a single environment, like Arm’s Pelion service, it is much easier to disconnect a device so it can be resold without creating vulnerabilities.

Attendees were also walked through how agile is changing the face of embedded software development. Niall Cooling, CEO, Feabhas, cautioned that an agile approach will need to “change the technical practices”. They also need to “change the technical practices”.

Cooling concluded that the embedded engineering community is still on a journey with agile, and that it is behind the wider IT community. There are two big sticking points that need to be addressed. Firstly, replacing tools that are anti-agile, and secondly ensuring management understand and act on the cultural shift that needs to go hand-in-hand with a shift to agile development.

Next up, Andrew Banks, Senior Field Application Engineer at LDRA, discussed the security implications of connected vehicles. Security must be designed in right from the start. This starts, he said, with writing code that is as simple as possible. Ensuring that happens means the code can be more easily understood, maintained and tested.

Then, Banks explained, that code should be tested around a model that captures every nuance of the hardware it will run on. This is particularly important in an automotive setting, as there are various environmental considerations that must be assessed. He said, “Running [the test] in the hardware you’re going to use has got to be part of your test strategy, unless you want your customers to be your final test engineers.”

Elsewhere, Felix Hovsepian, CTO at Blue Manifold discussed AI at the edge. He explained businesses need to grapple with this issue as there will be applications where it is inefficient or there is not enough time to send all data to another place for processing. One issue he highlighted is that a lot of discussion of artificial intelligence (AI) is really talking about machine learning (ML). One common misconception is that AI is not rigidly defined, but there has been an accepted definition for decades. A true focus on AI, Hovspian said, will unlock swarm intelligence. That means true, distributed computing where single processors can contribute to a collective intelligence.

Hovspian explained, “We need the next generation of people coming through computer science degrees to start looking at some of these concurrent distributed systems. As a CTO, I’ve taken on very good computer science graduates and then realised that their ideas of what threading is or the actor model or CSP or other kinds of distributed processing or concurrent processing is quite weak.”

“This is a good way to help them understand that you can’t just replicate sequential processing. That doesn’t work. You need to understand on a holistic level what’s happening between all these different computational devices. There’s interaction between each of them, and it’s that interaction that generates the intelligence.”

The range and complexity of Arm Cortex-M processors offers engineers endless possibilities, particularly with the growth of IoT devices. What’s vital is that the right foundations are laid today so these are sustainable and scalable in the future.
Less is more

congatec and the Japanese AI experts at Hacarus unveiled the world’s first embedded computing kit for Artificial Intelligence (AI) that uses Sparse Modeling technology. Sparse Modeling needs little training data to make highly accurate predictions. This is an advantage for vision-based inspection systems, among others, because the reject rate is naturally lower when manufacturing quality is high. With Sparse Modeling it is possible to create a new inspection model starting with 50 or even fewer images. This is significantly less than the 1,000 or more images required for traditional AI. The Sparse Modeling Kit, available from Hacarus, can be used stand-alone or as an add-on to existing inspection systems. Primary customers are vision system providers and system integrators. Another group of users includes machine and system builders who want to use vision-based AI in their devices but have been reluctant to do so up to now, because the wide variety of individual customer installations requires algorithms to be adapted, which was previously too costly.

With Sparse Modeling, developers are able to build next-generation inspection systems that can be trained for individual requirements and can therefore function anywhere. There is no longer a need for optimal conditions, such as constant lighting. OEMs also gain greater flexibility to adapt to changing production processes, which is essential for the move to industrial IoT/Industry 4.0 controlled batch size production.

Essentially, Sparse Modeling is a data modeling approach that focuses on identifying unique characteristics. Simply put, Sparse Modeling interprets data similar to the human brain, instead of analyzing every single hair and every millimeter of a person. It is therefore not necessary to process the entire volume of big data – as is the case with conventional AI – but only a few select data. Algorithms based on Sparse Modeling reduce the data to these unique characteristics. This also makes for a much smaller AI footprint, which is ideal for fanless low-power systems that are in continuous 24/7 use and have only a limited power consumption margin to integrate AI.

Starter kit with scalable hardware platform

The new starter kit based on congatec hardware and Hacarus software can instantly be deployed and tested in any GigE Vision, 1 x USB3.0/2.0, 4 x USB2.0 and 1 x UART (RS-232) environment. Designed on the basis of palm sized Computer-on-Modules, the system measures only 173 x 88 x 21.7 mm (6.81 x 3.46 x 0.85 in). It is not only slim but also offers extraordinary performance thanks to the latest Intel Atom and Celeron processors (Codename Apollo Lake) that are all available for series production today. Despite its small size, the system has a rich set of I/Os, enabling many different end user setups. Standard interfaces are 2 x GbE application ready for GigE Vision, 1 x USB3.0/2.0, 4 x USB2.0 and 1 x UART (RS-232). Extensions are possible with 2 x Mini-PCIe with USIM socket, 1 x mSATA socket and 16-bit programmable GPIO. The wide range DC voltage input is 9V-32V.

About congatec

congatec is a rapidly growing technology company focusing on embedded computing products. The high-performance computer modules are used in a wide range of applications and devices in industrial automation, medical technology, transportation, telecommunications and many other verticals. congatec is the global market leader in the Computer-on-Modules segment with an excellent customer base from start-ups to international blue chip companies. Founded in 2004 and headquartered in Deggendorf, Germany, the company reached sales of 133 million US dollars in 2018. More information is available on our website at www.congatec.com or via LinkedIn, Twitter and YouTube.
Predictions from different industry analysts suggest that alongside the industrial market the key growth markets for robotics in the coming years will be in agricultural robots, social functioning ‘companion’ robots and assisted living robots.

According to Professor Manuel Giuliani, who leads the Bristol Robotics Laboratory’s (BRL) Embodied Cognition for Human-Robot Interaction (ECHOS) Team, these developments are unlikely to see robots completely replacing human workers, but rather we will see the rise of cobots, whereby robots will work alongside humans. Robots will operate and come into much closer proximity with humans, whether they are co-workers, patients or customers, than is currently the case and that will require them to have full awareness of their surroundings and be able to adapt and modify their behaviours in response to environmental changes.

Workers coming into contact with robots will need to be trained to operate safely alongside them.

Jeremy Hadall, Chief Engineer for Intelligent Automation, Manufacturing Technology Centre, makes the point that, “Industrial robotics have been caged since their inception in the 1950s, with collaborative robots only being developed in the last ten years.”

“One of the issues with the development of ‘cobots’ has always been how do we make them interact with humans safely yet still leverage the benefits large industrial robots can bring. By understanding that interaction we’ll be able to develop a more effective collaboration between humans and robots.”

While that may be possible with workers, when it comes to the general public that is simply not going to be the case - at least in the short term.

There are certainly barriers that could prevent, or delay, the more widespread adoption of robotic technology. One of them is how we’ll look to communicate with robots - will that be via human dialogue, which is complex, or by using gesture and body posture?

These are important issues but the role of the human is likely to remain essential in terms of soft skills, such as understanding employees’ feelings or creating a work culture, so the work of robots and humans will need to complement one another.

As traditional jobs disappear, it’s likely that new and more skilled ones will appear.

Human Robotic Interaction

Back in August a group of companies, including the Small Robot Company and the John Lewis Partnership, gathered at Google’s London HQ with the aim of accelerating the development of safe and ethical robotics that consumers and workers would be able to trust, and they put in place a number working groups to come up with what will be the world’s first blueprint for Human Robotic Interaction (HRI)

This HRI blueprint is intended to be an open framework that will evolve over time.

Not only is it intended to be a ground-breaking initiative that will foster and accelerate the safe and ethical adoption of robotics across British industry, it is also intended to help define how autonomous robotic technology should interact with people in the real world across different environments and sectors.

Isaac Asimov, the famed science fiction writer, is credited as the founder of the first laws of robotics when in his 1942 short story ‘Runaround’ he outlined three rules that should govern robot behaviour.
These famous rules include: autonomous machines must not harm a person, they must always obey orders and protect its own existence but without compromising these other principles.

Today, we are seeing an explosion in autonomous robotics fuelled, in large part, by Artificial Intelligence.

In the UK alone, active industrial robot numbers have grown by 30%, according to the International Federation of Robotics, highlighting the need for a framework to govern how robots interact with humans.

The HRI blueprint will look at and define the proper characteristics and states of the robot persona: how the user/robot relationship should function; how robots should be properly programmed - to ensure people find them engaging, trust-provoking and safe; how a robot should interact within the boundaries of its geospatial map and how a robot should respond to humans it encounters during the course of its work.

According to John Vary, a Futurologist at the John Lewis Partnership, “Britain is a melting pot for robotics innovation and the use of autonomous robot technology, to assist human workers, is a very real prospect for the future.

“Before we can get there, however, we will need to define how that relationship works.”

Ben Scott-Robinson, co-founder, Small Robot Company, adds: “Real world robotics is set to explode. Powered by AI, robots are now becoming truly autonomous and we’re about to see a massive influx of commercial robots into the consumer domain whether in our shops, our factories, our hotels, our streets and our fields. It’s vital that consumers can trust and feel comfortable with these encounters.”

Other collaborators on the HRI initiative include the design consultancy Method, The Manufacturing Technology Centre, The Turing Institute, Dr Karina Vold of the Leverhulme Centre for the Future of Intelligence, robotics designers Konpansion and industrial robotics start-up ZOA Robotics.

Collaboration

“When it comes to the deployment of robotics, from the perspective of retail and the supply chain and distribution, we have been using automation for quite some time,” explains Gavin Jones, Innovation Manager at the John Lewis Partnership.

“At the company’s state-of-the-art semi-automated warehouse at the Magna Park Campus, outside Milton Keynes, we use an automated storage retrieval system and have developed what we call software robots that, in effect, are able to emulate what a person would do with a piece of software and interact with applications and our systems.”

Looking at HRI, a growing number of robots are now performing service functions, according to Jones.

“Manufacturers are testing delivery robots and in-store robots that can clean floors and check on stock availability within stores. That growing interaction means that we need to better understand how robots will interact with staff and customers – that could have a significant bearing in terms of the company’s brand and how that’s represented.

“We’re seeing a lot of changes as to how distribution centres work because of automation. But we see robots complementing, not replacing, the work of humans and at John Lewis they are seen as not only benefitting the consumer but as contributing to and improving the welfare of our partners.”

Jones makes the point that while robots will continue to evolve the role of humans will have to change too.

“The nature of jobs will certainly change with the arrival of high-tech robots, and I believe that we will see new and better roles being created. We need to be ready to up-skill our staff and improve their opportunities in terms of career progression. But that extends across society as a whole – how will we support people affected by change and share the benefits of improved productivity?”

According to Scott-Robinson,
the HRI project is about ‘real world’ robotics and how we, as consumers and users, will interact with them.

“When people begin to see robots on the street or in a field, for example, they won’t be super glamorous they will simply be doing a specific job. Those will be the most common form of robots and people will notice them first – they will also ignore them the fastest too.”

According to Scott-Robinson: “My expertise is in designing for the user experience and that is a two way relationship. How does the user interact with a ‘thing’?

“When it comes to robotics the user won’t actually be the person interacting with the robot, they will be many miles away and connected via the Internet.

“That means that robots will be interacting with people on a daily basis who have no control or say over what they do. They will simply be interacting with rather than using them, and that is a fascinating challenge for companies operating in this space.

“Whether a robot is deployed in a power station, monitoring shelves in a store or delivering parcels, they will have to be able to operate around people and interact with them in a way that is acceptable and safe.

“If the HRI project can define that relationship then we can create ground rules, so that if something does go wrong we can point out that it contravenes specific design rules and, ideally, we can stop those problems occurring in the first place.

“What we are trying to avoid is if something does happen that there isn’t a ‘panic’ or knee-jerk response from the authorities.”

Both Jones and Scott-Robinson are clear that with the deployment of robotics it’s not about replacing labour but rather creating new roles and freeing up people to be more creative.

“If we look at agriculture it is labour intensive and low paid. If there were enough people looking to work in the sector, robotics wouldn’t have a look in – it’s far too expensive,” explains Scott-Robinson. “Robotics only become viable if people become scarce. Talking to farmers in the US that is becoming a big problem as their normal supply of skilled workers is falling away, so they are looking to robots as a solution.

“That’s an example of ‘push’ rather than ‘pull’ in terms of using the technology. By contrast in the arable space farmers are looking to technology to carry out menial tasks in what is already a heavily automated sector.

“If farmers are able to use robots to automate repetitive and time consuming activities they will have more time to think creatively about what crops they want to grow; how they can diversify what they grow and develop new products and markets.”

“That is a great example of the dynamic use of technology,” says Jones who points to how the retail space, which is itself going through dramatic changes, is looking to embrace technology and use it to complement, rather than replace, the human element.

“‘When people begin to see robots on the street or in a field, for example, they won’t be super glamorous they will simply be doing a specific job.’

Ben Scott-Robinson

“For John Lewis partners, technology will give our staff the time to do what they are best at – supporting and engaging with customers. By using robots to undertake repetitive work, automation can be used to keep the wheels of business turning while enabling staff to be retrained and redeployed.”

The HRI blueprint is seen by both as an opportunity to define the rules associated with the development of robotics.

“It’s a chance for the robotics industry and for the industries that it will look to support, to develop and provide guidelines for companies and engineers – who, to be honest, are not always focused on the impact of their ideas on other people. We want to take that burden off engineers, give them guidelines to work towards, and provide a set of unified standards and rules about robotics behaviours,” says Scott-Robinson. “Standards and rules that can then be the basis of legislation.”

“It will help people to understand what robotics will be able to do and provide a guide to working with and alongside robots, as well as what people will be able to expect from a robot in terms of how it reacts and communicates with them.”

Both men argue that the project’s aim it to ensure that the public can have confidence in the industry – that’s about delivering much greater trust, accountability and acceptable levels of behaviour,” explains Jones.

“‘We believe the output of this initiative will provide valuable decision-making tools to anyone who is looking to create a real world robotic solution and will help to create an ethical framework for robotics and AI which puts safety first.’

Above: An example of how robots could be used as a social companion for the elderly

Image: Fraunhofer IPA, SATOKO KAWASAKI

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Andrew Skinner is a trade lawyer, practising export controls and sanctions, anti-bribery and corruption, and customs law.

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Originally a spin-out from Bristol University, XMOS has successfully established itself as a fabless semiconductor company that develops the chips and embedded software that address not only the needs of the audio market but, increasingly, enables voice interaction across a wide number of products.

Today, XMOS is heavily focused on the fast developing audio space - around 80 percent of its business is derived from audio - and it has successfully positioned itself to take advantage of a market that has not only undergone profound change in recent years but, with the rise of voice as the key interface in a growing number of devices, is expected to see even stronger growth in the coming decade.

The acquisition of Boston-based Setem Technologies, a pioneer in Advanced Blind Source Signal Separation technology, means that XMOS is now in a position to develop consumer devices capable of focusing on a specific voice or conversation within a crowded audio environment. It’s a technology that will help XMOS to optimise its speech-recognition systems and has been described as a game changer for the company.

At the head of XMOS is CEO Mark Lippett who, as employee ‘number 6’, has been with the company from almost the very beginning.

“Originally, we were set up to address what was seen at the time as a major problem for embedded software engineers in the consumer space. They were simply not being supported in their efforts to differentiate their products,” he explains.

“Cost has always been a crucial factor in this segment and the reference designs that were available were often inflexible and constraining, robbing design engineers of the opportunity to innovate. The only options open to them were to develop an expensive ASIC, while the FPGA community were focused elsewhere and they were too expensive,” he explains.

In response, XMOS developed and went to market with a microcontroller architecture that enabled engineers to continue to develop C based solutions but which also enabled them to create differentiated products, as they could now write their own IO protocols in software and change the nature of the hardware. At the same time they retained the ability to write control and DSP software.

“We took that to the market and
almost immediately were drawn to the audio space,” Lippett explains. Fate also played an important part at this point in the company’s development. The launch of this first-generation architecture coincided with Apple’s decision to pull FireWire and its ‘suggestion’ that the ecosystem it supported should switch to a USB audio class, in order to provide an interface for audio peripherals.

That, in retrospect, was a critical decision that helped support XMOS’s platform and encouraged its move into the audio market. “Apple’s decision provided a serious discontinuity in the audio market at the time,” explains Lippett. “Our platform made it possible to develop solutions far more quickly and it proved such a success that Apple started to recommend XMOS as a partner.”

According to Lippett, “While we were delivering a high-class audio solution, built on a general-purpose platform, we soon recognised that we could also take our core architecture and add DSP features to it, while retaining our IO capabilities.

“By adding those heavy lifting DSP capabilities, we started to gain much greater access to the USB audio market and, as a company, we were able to position ourselves to not only address the audio playback space but, crucially, start to enter the fast-emerging voice market.

“The exciting thing about the audio space is that although it’s glamorous, it’s also very demanding. It gave us the opportunity to refine and hone our skills.”

Through 2013-14 XMOS noticed that customers were looking increasingly at far-field microphone technology and using the company’s architecture to deliver products.

“At the time we were experimenting with AI and thinking about how we might deploy it alongside our existing hardware and DSPs at the edge,” Lippett explains.

“The voice market was beginning to emerge, and we knew it had the potential to be huge. Today, it accounts for between 10-20 percent of our business.”

Lippett, however, suggests that we should draw a sharp distinction between the market as it is and the hype that surrounds it. The voice market still needs to develop, “it’s not in its fully developed form yet, but it will be the communication mechanism of choice.

“Audio had tended to be overlooked and was seen by many as a comparatively simple problem to solve. That has changed as audio has become a more important element in the consumer experience. The arrival of the voice market has been a game changer.”

**Target markets**

Like most companies of its size, XMOS has been very focused in terms of the specific categories within audio that it looks to address.

“We have had some high-profile wins in the smart speaker’s market, but that is what we call a ‘red ocean’ market distorted by the likes of Amazon and Google,” says Lippett. “It’s a difficult one for a component vendor like XMOS to operate in.

“Our focus has been on smart TVs, set top boxes and sound bars and there’s been a real pull from the high-volume TV vendors for our technology – you can now find intelligence in a much broader range of products today.”

According to Lippett the next big wave, in terms of voice deployment, will be in the existing audio categories such as TVs, set top boxes and speakers as well as in the automotive space.

“Voice interaction on earbuds has been a fantastic use case,” he enthuses.

“Beyond that what we’re seeing, and which in many respects is being driven out of China, is growing demand for voice in things like domestic appliances and domestic well-being devices.

“We are also seeing the development of solutions that are significantly more competitive in terms of cost. That’s critical if we are to see voice deployed in low priced consumer products. You need a processing platform that is inexpensive but also low in power.”

With the advent of AI and voice Lippett expects to see different sensors being developed and far more integration going forward.

“We will see more classes of sensors being part of the story as well as the growing use of AI,” he suggests. “Greater consolidation of sensors will be driven by AI and computing at the edge.”

“There are a broad range of issues that need to be addressed when it comes to voice and that usually requires a combination of signal processing and AI, which means the use of neural networks and DSP techniques to clean up the quality of the signal.

“The quality of that signal will be determined by the environment, so we have to employ techniques such as beamforming, interference cancellation and noise suppression to achieve the best outcomes and these all require power.”

Another area of interest is where the processing will take place, according to Lippett.

Today most processing takes place in the cloud and that is likely to have to change with the growth in the use of voice across so many devices. Processing will have to be done at the edge, he argues.

“The issue with this, however, is how can we do that while balancing cost, performance and power?

“With the drive to make products smaller, our focus has to be on architectural innovations and delivering the additional processing load that’s going to be required. It might be ok to develop a co-processor to sit alongside existing silicon but that, in all honesty, will only be a temporary fix.

“AI capability is going to have to be absorbed into the system, otherwise the economics just won’t stack up.

“That’s why XMOS have been working on integrating the system into the same device and we have plans to unveil a series of new solutions over the coming few months.

“It’s all about technology and timing, in this industry,” suggests Lippett, “and I believe we’re in very strong position going forward. We have an established legacy to build on and there are some great opportunities in this space going forward.”

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**INTERVIEW**

**MARK LIPPETT**
The test and measurement industry is ready for the 5G era, but diving into its different functionalities and applications shows some questions still remain. By Charlotte Hathway

When it comes to emerging technologies, the test and measurement industry has to be the frontrunner for the simple reason that you can’t evaluate the functionality of something without the ability to test it. Over the past year, discussions have been dominated by the topic of 5G. That once high-level topic is becoming more nuanced as the simpler questions are answered by the initial roll out.

The different phases of 5G mean that test and measurement devices need to be adaptable and scalable as new functionalities become available. “Like previous generations, 5G will roll out not just as a longer-term network build-out paced by policies and network operator capex plans, but also by the evolution of the standard,” commented Roger Nichols, 5G Program Manager, Keysight Technologies. “Therefore, 5G-specific network testing is an ongoing process with phases dictated by the rollout of features based on new releases of the standard.”

One issue for network operators is that they need to be able to test products and devices that don’t yet exist. For this reason, National Instruments (NI) has developed test user equipment that emulates a 5G handset. Sarah Yost, Senior Product Marketing Manager at NI explained: “We’re still pretty early in the game, so a lot of updates are still being made on the software side for base stations and other equipment even if some of the hardware has been initially deployed. [Test user equipment can provide] a golden reference to run against the base stations to make sure the equipment is working.”

Yost added that this need for user test equipment is driven by 5G’s inherent densification disrupting the base station ecosystem. Mobile network operators are still deploying their own base stations, but small cells are becoming increasingly widespread. As such, there is more demand for base station equipment, but these small cells do not have access to the same resources.

“The big traditional players like Nokia, Ericsson, Samsung and Huawei get support from semiconductor chipset makers. Companies like Qualcomm create MTPs – mobile test platforms – that can be connected to the base station and provide diagnostic information, such as throughput, across the different communication layers,” said Yost.

The issue is that those MTPs are not widely available or particularly user-friendly, so small cells can have difficulty procuring user test equipment to validate their network. Yost added that “once we start looking at applications like industrial IoT, we’ll start to see more demand for private networks so there can be certain guarantees of quality of service. That means we’ll see a little microcell deployed for factory, for example, and that brings a whole new level of complexity.”
**Going beyond cable testing**

To deliver widespread coverage and support all use cases, 5G will use spectrum within three key frequency ranges. One of these, mmWave, has not previously been used for mobile broadband, and whilst it is now new to the test and measurement industry, it has created a new requirement for beamforming. Frank Groeger, Director of Technology Management at Rohde & Schwarz said, “If you use higher frequencies, you also have a higher path loss. That means it is necessary to apply beamforming to direct the waves to the user and that can be done with the use of antenna rays. This means that you cannot test by a cable connection like in the past, now you have to test over-the-air.”

Alejandro Burrica, Senior Solutions Marketing Manager at NI, explained why existing mmWave development was not necessarily helpful for the 5G era. “A lot of existing mmWave test equipment was developed for other industries like satellite communications, radar, military or aerospace – so it’s got a pretty steep price tag.” He added that having to test over-the-air brings with it “intricacies and difficulties” such as having to “keep track of the [path] losses”. Test engineers and designers also need to “calibrate the fixtures and distances to be able to guarantee the measurement quality of these devices”.

The rise of 5G is also changing traditional test equipment set-ups. Groeger explained that because test equipment often needs a higher accuracy than the system being tested, the computing power you need could be enormous. He said, “Test equipment [should be] tailored to a specific test task and in some cases ultra-high performance is needed. In those instances, you’ll need dedicated and tailored hardware.”

Keysight Technologies’ Nichols added, “While the dedicated application-specific test controller is a thing of the past, we still provide a variety of approaches. These range from stand-alone test products, like an RF network analyser, in which embedded PCs run applications to provide added insight to the information gained from the measurements; to complex systems with multiple racks of measurement equipment.” The company also offers set-ups that integrate with cloud-based systems as these are needed with Industry 4.0 set-ups.

**Understanding test results**

This additional complexity calls for new techniques to make test results understandable. Vikas Chauhan, Business Development Manager for EMEA Wireless Business at Anritsu, said, “The focus of test results is not only the wireless chipset itself, but not the testing of that chipset.” Chauhan added that Anritsu’s test logs can be exported in HTML or CSV, so users can further analyse the data in a format they need. This chimes with the view of Nichols. He said, “Providing insights to our customers is one of our most important tasks. We ensure that measurements are traceable to primary standards [and] most of our measurement equipment has software applications that provide multiple ways to view the measurement results, which enable insight.” Nichols added that the company is also “using data analytics and artificial intelligence to help customers make more sense of large quantities of measurement data”.

**Future requirements**

The real gamer changer for the test and measurement industry will be in a few years’ time when market growth brings costs down.

According to NI’s Yost, “from the massive IoT standpoint, I think the most challenging thing is hitting the price point that the market demands. 4G and connected devices have bought down the cost of wireless sensors. But if you think about setting up a smart factory, there will be hundreds of nodes in a single factory, so you don’t want those nodes costing more than five or ten dollars. There’s this big push to bring down the cost point of not only the wireless chipset itself, but also the testing of that chipset.”

These vertical applications of 5G are where the standard will make the most difference.

Anritsu’s Chauhan said, “In truth, the key 5G evolution is about enabling the industry verticals. The automotive industry will be able to achieve more autonomous driving capabilities through car-to-car communications, and smart manufacturing will be made possible through the availability of private 5G networks.

“There will also be new possibilities in agriculture, for the medical industry, as well as within utilities and transport. 5G will become a core part of our life by meeting the needs of these industry verticals.”
The troubled Crossrail project, which was due to open in December 2018 could, by its own admission, be facing even longer delays. By Brian Wall

It’s a question that has surfaced again and again: when will Crossrail be ready? Due to the “complexity of the remaining work”, Crossrail has confirmed that the opening of the central section will not now occur in 2020. Instead, the line will open “as soon as practically possible in 2021”.

So, why the delay? A major factor has been the failed efforts to match a new signalling system in the central 13-mile stretch of tunnel with software on the new trains.

Officially called the Elizabeth line, the project was originally costed at £14.8 billion, but is now over budget by between £2-3 billion.

According to the project’s CEO Mark Wild: “The two critical paths for the project remain software development for the signalling and train systems, and the complex assurance and handover process for the railway; both involve safety certification for the Elizabeth line. These must be done to the highest quality standards to ensure reliability of the railway from day one of passenger service.

“Crossrail will need further time to complete software development for the signalling and train systems and the safety approvals process for the railway. The Trial Running phase will begin at the earliest opportunity in 2020. This will be followed by testing of the operational railway to ensure it is safe and reliable.”

Complexity not recognised

These delays are not totally unexpected. Undoubtedly, it is a highly intricate undertaking that was never likely to reach fruition without testing the nerves – and pockets – of those responsible for delivering the finished article.

First, the Elizabeth line, running between Reading in Berkshire and Shenfield in Essex via central London, serving 41 stations, including 10 new ones, has to operate under three separate signalling systems across the 60-plus mile route, joining what were essentially two Victorian railways – the Great Eastern and Great Western – to the new construction.

As Crossrail technical director Colin Brown pointed out: “There’s a mish-mash of technologies involved, some of which date back to the 1950s’ Automatic Warning System [AWS], alongside the upgrade, the Train Protection Warning System [TPWS]. So, Crossrail has the unenviable task of being future proof, in terms of having the latest technology, and at the same time trying to make the railway last for a hundred years.”

What Crossrail will deliver, he says, is the first interoperable railway we have in the UK. “And it’s interoperable because of the European Rail Train Management System [ERTMS] we’ve chosen to be the heart of the system, as a modern, future-proofed and safe system of separating trains.” However, the challenge when getting ERTMS to work in the UK is that it has to be made compatible with the two legacy systems, AWS and TPWS.

Yet there is an even bigger challenge, adds Brown – and that is making the whole signalling solution work as a metro system through the tunnel itself. “So, we’ve had to incorporate into the mix another signalling system called CBTC [Communication Based Train Control], developed by Siemens. This is as you would see on any mass-transit system: high precision, in that it can manage stopping distances very accurately to align doors, as well as provide additional levels of safety, tunnel ventilation and timetabling, plus deal with how the service can recover from problems that happen in a metro scenario.”

Software issues

Meanwhile, ‘dynamic testing’ of the trains in the tunnels remains underway, using four Class 345 trains.

A key objective is to identify and fix any software bugs in the train control system and to make sure everything works as planned. So far, achieving that goal has not been without its problems. The latest Siemens software configuration PD+10 (Siemens Mobility is responsible
for the signalling) was planned to be the first version capable of supporting entry into trial running. However, testing in the Crossrail Integration Facility identified some missing functionality and defects. As a consequence, the next software configuration, PD+11, will now be the candidate for the start of those trials.

“The use of software configuration PD+11 is still consistent with starting trial running in the first quarter of 2020,” insists Crossrail, “and our declared delivery window between October 2020 and March 2021 for the start of services through central London.” However, there’s a caveat that will cause concern to all those with a vested interest in the project’s earliest completion. “If another revision of the software configuration is required, the opening window would still be valid, although under increased risks. The nature of software development means uncertainty will remain until we begin to test each version.”

Rapidly aging system
Looking beyond Crossrail, the UK railway network is an old one. Around half the network is more than 30 years’ old, with the electronic systems that control it of a similar age, while the rest is operated by electro-mechanical and mechanical systems that date back to Victorian times. Now, with a rapidly ageing signalling system and growing pressure to meet capacity needs, modernisation of the system has become an essential part of Network Rail’s strategy for delivering a vastly improved and efficiently operating infrastructure.

The scale of the challenge it faces isn’t difficult to see. Since the mid-1990s, the number of passengers using Britain’s railway has doubled. Upgrades to signalling and train control systems feature strongly in Network Rail’s improvement works and are part of its ongoing plans to install modern technology to improve services for passengers and freight operators.

Signalling is, of course, a crucial part of the railway infrastructure, enabling trains to move safely around the network. The broader signalling system also includes systems for determining the position of trains, controlling the railway and operating the timetable, along with points that control the directions trains take.

Other systems determine what movements are safe, while train protection systems guard against mistakes by drivers. Signalling systems are designed to fail to a safe state, so faulty components often result in signals remaining at red, causing train delays.

Most signalling systems use trackside signals to control the safe movement of trains and tell drivers what to do. However, modern signalling systems provide the necessary information to the driver on displays in the train cab.

“This means the future of railway signalling belongs inside the train, bringing all information from one of our operating centres nationwide to the driver, instantly,” said Network Rail’s Michael Flynn, Digital Railway’s programme director. “Digital signalling unlocks the space needed to enable greater flexibility about where, when and how fast trains run. Currently, timetables are planned, mostly manually, between two and four years in advance and are then largely fixed. Digital Traffic Management transforms this, harnessing modern analytics to create more effective ‘conflict-free’ timetables and options for new train paths that can be adjusted as demand changes from day to day, week to week and season to season.”

Total automation
Introducing the latest signalling and control technology is part of the European Train Control System (ETCS) and traffic management programme. Digital signalling is also a potential first step towards the use of fully automated trains, as Automatic Train Operation relies on data from the ETCS to set the speed of the train.

Although there are already driverless trains in the market, they are mostly used in metro systems and still have a driver or attendant on board. Fully autonomous trains will require similar sensor technology as driverless cars to know what is on the track in front of them and to make decisions for themselves. In the five years between 2019 and 2024, the aim is to install digital technology on the southern part of the East Coast main line and routes across the Pennines. These targeted schemes form the basis of digital train control as the norm across the rest of the network from 2024 and beyond.

Clearly, whether it be Crossrail or the broader UK railway network, there is still some way to travel before reaching the intended destination.
Since the mid-2000s, computer architecture has fractured. Up to that point, processor designers and their users could rely on clock speed and process improvements to deliver more compute cycles for the same money and energy.

Then Dennard scaling, which behind the ability to deliver many of the improvements, suddenly hit a wall. Peak clock speed stopped dead in its tracks at around 3GHz and the evolution of superscalar processors slowed dramatically, because the dynamic instruction schedulers they needed chewed through too much power.

Homogeneous multicore architectures at least made it possible to exploit the fact that, while Dennard scaling was no more, Moore’s Law was still providing twice the transistors every two or three years. But even that has slammed into a wall because trying to keep multiple high-speed processors going, complete with caches and memory interfaces, needs more cooling than most system designs can afford.

If you do not want to keep all the transistors powered at once and are happy to keep large chunks of the die dark, those additional transistors can go into accelerator units tuned for specific classes of application. The cost comes in software. Compilers need to become much more complex because of the sheer range of architectures with which they now have to deal.

In the glory days of the RISC processor, the individual architectures were conceptually similar. You might get differences in pipeline depth and fine-grained instruction scheduling. But, fundamentally, code generation for pretty much all processor architectures designed since the end of the 1980s could employ the same core optimisations.

Accelerators greatly expand the architectural space and work with entirely different compilation strategies. Organising data for a processor armed with a cache for optimum performance can be quite different to doing the same for a single-instruction, multiple-data (SIMD) accelerator designed to work on vectors.

The cache-based memory accesses of the processor favour short offsets that can hit elements in the same or nearby cache lines that have already been filled. The compiler will unroll tight inner for…to() loops to support this but it has to watch out for dependencies as the code iterates through the loop if the results need to be summed.

For a vector unit, it may make more sense to operate on more widely distributed data with a much bigger stride between elements and possibly with the luxury of working with fewer dependencies.

In effect, it will run multiple copies of the same inner loop – with different groups of data – in parallel. In order to do so, the compiler has to unpick the source code and determine how nested for…to() loops are related to each other.

Polychedral compilers
Derived from ideas first proposed in the late 1960s, polyhedral compilers use geometric techniques to map the sequence of operations in nested loops and their dependencies. The operations cover techniques such as carving up matrices of operations into tiles that can then be distributed in parallel across accelerators that match those tile dimensions.

Whereas, the handling of multidimensional matrices or tensors used to be isolated to high-performance computing, applications such as machine learning are shifting these kinds of workloads onto embedded systems.

An additional wrinkle for embedded systems that have to deal with machine learning and similar tensor-processing problems is that they need to handle not just highly regular convolutional operations, which can take advantage of the pipelining and parallelisation that suits dense matrices, but irregular sparse matrices.

For example, the pruning of deep-learning networks equates to setting to zero many of the cells in the tensor used to calculate the overall effect of the neuronal weights on an input.

An optimisation employed in some machine-learning processors is to use data compression on weights to reduce the impact of the zero weights – they are discarded at decode time with only non-zero weights fed to an execution unit. But a more general-purpose technique is to adapt polyhedral compilation to map sparse matrices into denser forms. To do so, the code generator may recruit address generation logic to perform scatter-gather operations and feed data into multiple execution units.

A big issue for the compiler is inferring what is happening in these increasingly complex codes.

Polyhedral compilers do a reasonably good job of determining the relationships between the nested loops that characterise the mathematically intensive code. But one approach that may help improve
results is to move to higher levels of abstraction in the source code.

A high-level abstraction can explicitly show what the operation is meant to achieve and relieve the compiler from trying to work it out from the shape of the code.

Domain specific languages

Even more intent can be captured using a domain-specific language (DSL). There will be operations that are commonly used in specific sectors that can be baked into the code analysis and optimisation functions. DSLs need not demand a complete move away from C or C++ and demand developers learn new syntaxes.

One example from Professor Jerónimo Castrillón’s group at TU Dresden is CFDLang, which is an extension to Fortran for the tensor operations used in fluid dynamics. He claims the extensions demanded comparatively little work to the underlying compiler but it was able to outperform Google’s TensorFlow because the compiler was able to take advantage of domain knowledge baked into the extended language syntax.

Although the focus of these compiler techniques is on the development flow, the high-level information captured by DSLs may wind up being taken through to the point that code is deployed. One of the arguments for edge computing is that it brings cloud-like agility to the way in which processes are assigned to hardware.

Industrial machine tools and robots may offload intensive AI and sensor processing routines to an edge server nearby rather than relying entirely on their own hardware, and not always the same server. Having the code move around can boost overall utilisation by scheduling things according to priority and resources.

Another proposal from the TU Dresden group is its TETRiS system, named after the block-based game. Applications are divided into chunks that can take advantage of different resources on a target platform. The scheduler fits these chunked applications around each other based on their use of resources to minimise conflict. In experiments the technique reduced variance in execution time and energy by orders of magnitude compared to the CFS scheduler used by Linux on a Samsung Exynos-based target.

Although compilers such as LLVM, with their multiple plugin back-end code generators, can readily target multiple accelerators, the issue for a runtime linker is which one to pick at any given time on arbitrary platforms.

This is where a standardisation effort at the IEEE may have an effect. The SHIM specification, which is expected to become the IEEE 2804 standard early next year, provides platform suppliers with a consistent way of describing the capabilities of accelerators so that modelling tools can estimate their performance.

One potential issue with an estimate of peak throughput is when multiple tasks are competing for resources on the same machine. Many workloads are far from consistent in their use of processor cycles over time and prediction needs to take this into account as can easily affect the decision on which accelerator to choose. It may make sense, for example, to pick one that allows tasks to switch in and out quickly but is slower than one with a large setup overhead as that will lead to fewer delays caused by contention.

There are trade-offs in these systems. Experiments by Mina Niknafs and colleagues at Linköping University in Sweden showed the overhead of running a predictor has an effect on system efficiency as does inaccurate estimation based on partial information.

But such performance analysers seem likely to prove essential as developers wrestle with the challenge of maximising their performance on a changing mixture of workloads on edge servers and embedded systems.
Enterprises nowadays are well-versed in the core benefits of operating within a cloud environment, ranging from flexible computing capacity to increased collaboration.

This is reflected in the clear trend among global enterprises migrating their operations into the cloud. According to Gartner, global cloud service revenues are expected to grow 17.5% in 2019 to a total of $214.3bn. More specifically, revenues for cloud management and security services are expected to almost double from 2019 to 2022.

Companies increasingly view moving business operations to the public cloud as both a cost-saving and efficiency-increasing solution. In reality, the process of cloud migration is often more complex than expected. The cloud does not always provide the simplifying effect it promises, and a poorly configured infrastructure migration can introduce additional risks and costs to a business’ operations.

Migration requires a clear strategy focused on long-term prosperity by directly aligning itself to company goals and culture and ensuring the best possible return on investment.

**The need for cost management**

Businesses often see migration to the cloud as a simple solution to common infrastructure issues that will simultaneously help to reduce costs. While a traditional on-premise IT infrastructure is managed at a flat operating cost regardless of how effectively it is utilised, an auto-scaling cloud deployment only requires enterprises to pay for what they consume. Generally, data usage in the public cloud is metered by the volume of storage used by a business.

Enterprises may therefore regard the public cloud as a cheaper
alternative to maintaining their own on-premise infrastructure. But in reality, if a cloud deployment is not underpinned by a robust plan for transformation, they may encounter unexpected and hidden costs.

Cloud usage charges can be compounded through poor configuration, maintenance and security practices. A lack of a clear plan can easily result in greater expenditures, including IT management costs attributed to employing more staff to manage a new cloud environment. The misconfiguration of a cloud setup can also result in the accumulation of significant costs from additional storage charges, not to mention the possibility of financial repercussions from a potential data breach.

According to Flexera’s 2019 State of the Cloud Survey, enterprises waste 35% of their cloud spend by not optimising their costs.

A key step towards avoiding unforeseen costs is undertaking a thorough audit of how the cloud will be used, giving consideration to how vital business tools and services will operate in the chosen cloud platform. Working with a trusted partner can add much-needed expertise to the process, and help to test and iterate on implementation plans.

The IT department must be selective throughout the process, assessing all existing applications and services, and making a clear plan on which should be migrated over to the cloud and what the benefits of doing so will be.

Establishing risk management
As more businesses opt to make the transition to cloud infrastructure, their cyber security must also transform. According to the 2019 Thales Global Cloud Security Study, only 49% of organisations encrypt sensitive data stored within the cloud. Poor cyber hygiene practices like this introduce unnecessary risk.

To compound the issue, data must be managed effectively in the cloud or it risks exposing the business to further cyber vulnerabilities. Failure to keep close track of its data can render an enterprise unaware of who can access it, as well as where they are able to access it from. The IT function may similarly find it difficult to implement critical security updates across its entire network if they don’t know how far the network extends. These problems are compounded when dealing with more than one cloud architecture. With no two cloud providers operating in the same way, it can become overwhelming for an enterprise to align multiple clouds under a single strategy.

In order to be able to adopt a clear strategy to secure what data it contains within the cloud, an enterprise must of course be conscious of what it is storing. Although cloud providers may provide some tools to assist enterprises in establishing visibility across the network, businesses must install a rigorous process for tracking their data.

Establishing visibility early on in the migration process will ease the transition by allowing IT specialists to pinpoint precisely which of its assets carry a higher risk profile than others. Attention should be paid to which users, devices, IP addresses, and geographic locations are able to access particular data sets, and particular high-value assets should have policies assigned to them.

Public cloud, or on-prem?
Since a significant number of recent large-scale data breaches were carried out by hackers through third-party services, businesses must be wary of who has access to sensitive data and what areas of the network appear to be most vulnerable. A meticulously planned transition can also negate the risk of breach by assessing whether certain sensitive assets are best stored on-premise.

“Any strategy must be malleable enough to incorporate the future use of multiple cloud providers without losing visibility or creating unnecessary security risks.”

There have to be justifiable benefits that outweigh the potential risks of transferring data to the cloud when it likely could have been more securely contained on an enterprise’s private IT network. This is especially applicable to companies that would encounter significant complications if data were to be compromised.

Finally, it is crucial to understand that cloud security demands cultural change across the business. With the ‘shared responsibility’ model, it is the company’s burden – not the cloud provider’s – to protect stored data from incoming hackers. Despite the existence of various vendor-supplied security tools, organisations have to take full responsibility for their own security practices. The most common risks within a cloud environment arise from the organisation’s own employees, usually through the misuse or misconfiguration of cloud services. This risk can be minimised by promoting security awareness and accountability among employees. Encouraging employees to follow strict security protocols can go a long way in helping a business protect its assets in the cloud.

Conclusion
Enterprises should understand that, although there are numerous benefits to transferring certain business operations to a cloud environment, they should not opt to make the transition without a robust strategy. As more business operations are shifted to the cloud, enterprises must establish a clear plan that takes into consideration all costs involved, keeps track of the risks associated with storing sensitive data externally and establishes a way for the IT function to maintain clear visibility throughout the cloud deployment.

Finally, the strategy must also be malleable enough to incorporate the future use of multiple cloud providers without losing visibility or creating unnecessary security risks.
What can we expect from next year’s show? **Neil Tyler** spoke with the CTA, the organisation behind CES, about what we can expect

Next month, the Consumer Electronics Show (CES) returns to Las Vegas and will again provide a global platform for over 4,500 exhibiting companies, manufacturers, developers and suppliers of consumer technology hardware, content and delivery systems looking to showcase the latest technology innovations.

From 5G and artificial intelligence to augmented and virtual reality as well as mobility and transportation, CES will bring together the latest and greatest that hundreds of tech companies have to offer.

This year there will be a greater focus on travel and tourism, data analytics and improving customer experiences, but there will also be the usual range of TVs, speakers, headphones, laptops and phones on display with many being optimised for the 5G/8K revolution.

In a meeting with New Electronics, CTA executive, Jean Foster, Senior Vice President, outlined a number of trends that are likely to take centre stage at the show in January.

“Transportation and tourism will be a key focus and the CEO of Delta Airlines will have a keynote at this year’s show,” Foster explained.

“CES has addressed these markets before but we are now seeing a growing use and deployment of facial recognition technology, for example, as well as other technologies across all aspects of passenger engagement both at the airport and on the flight.”

These types of technologies include the use of data analytics and one of the key sessions at this year’s conference, according to Foster, will be one looking at the issue of privacy.

“It’s certainly not been a great year for the technology industry and the issue of privacy has increasingly taken centre stage, but at this year’s CES we are looking to address that issue head on. In what will probably be a key conference session we have the Chief Privacy Officers of Facebook and Apple on stage together, along with the Commissioner from the Federal Trade Commission, among others, to debate the issue. We’re planning to stream this.

“Looking to other sectors, automotive continues to grow strongly and we have all the major car manufacturers in attendance, this year. But the focus is not solely on vehicles. The whole transportation sector is heavily represented, and we’ll be looking at technologies as diverse as drones and marine technology,” said Foster.

For the companies that have traditionally used CES to make ‘big announcements’ Foster said that she expected that this year would be no different.

“Last year we saw some major announcements from the likes of AMD and Intel and I’m expecting to see the same this year.”

In 2019 AMD showed off its first ever 7-nanometer GPU, the Radeon VII, while Intel used its CES keynote, to unveil the first 10nm Ice Lake processors based on its Sunny Cove architecture.

Intel also unveiled 9th-gen processors, ranging from Core i3 to Core i9, which made the event one of the biggest launches the company had recently undertaken.

There are rumours that Intel will use 2020 to unveil a discrete GPU and/or to announce a new 10nm desktop CPU now that 10nm mobile chips are available.

Nvidia revealed its GeForce RTX Mobility graphics cards at CES 2019, alongside the RTX 2080 and other cards for gaming laptops but, as yet, has not revealed what they might be discussing at this year’s show.

For some of the other big players in this space – i.e. Samsung and LG – it’s expected that we will be seeing more of the same, from a new series
of OLED TVs to LG officially debuting its transparent OLED prototype that it only showed to a select few behind closed doors at last year’s show.

Also we can expect to see hundreds of new domestic appliances, all of which will come with the ‘smart’ label.

CES is always a big show for Samsung. Last year it unveiled the new 219-inch TV called The Wall and gave visitors an updated look at its Tizen operating system that included Apple TV. This year, a new QLED TVs with zero bezel is expected.

Resilience
This year CES will also be looking to address the issue of resilience.

“When we talk about resilience we are looking at how technology can, in a sense, be used for good, and how technology can be deployed to address major global problems, whether that’s environmental or man-made disasters.”

“We have a partnership agreement with the World Bank and will be launching a global challenge on stage calling for companies and individuals to come up with solutions that address problems associated with the issue of resilience,” said Foster.

“Another area of real interest at CES in 2020 will be on gender and gender bias as we look to counter the ‘tech wash’ narrative that we’ve certainly been seeing in the US. Our focus will be on talent and diversity in the technology space.

“We’ve taken a few hits over the years,” Foster conceded, “by not being truly representative or having a more balanced representation among our speakers. But, it’s not just about tough discussion as we want the very best speakers, because CES is still a technology show.

“Diversity and inclusion, and what that means for the tech industry, are big issues and I think we all realise that a more diverse workforce is going to result in a more successful technology sector.

“We have been working with the Female Quotient – which was founded by Shelley Zalis to provide companies and business leaders with research, tools and experiences to promote equality - to ensure that more diverse voices are heard at the show this year.”

One area in which there continues to be rapid growth at CES is in digital healthcare.

“The number of apps that are being developed are growing rapidly and that has been reflected in the number of companies coming from this space to CES,” explains Foster. “I believe it will continue to grow rapidly in the coming years.

“In possibly a first for a show like CES doctors attending the event will now be able to gain medical education credits which they need to retain their license to practice here in the US.

“Remote medicine, teledicine and robotics - and a growing use of facial recognition, particularly to the dispensing of medicines if that’s carried out remotely – is driving innovation in this space,” according to Foster.

“Another area of particular interest is in the use of VR. At the University of Southern California they are using VR to treat PTSD – it works by forcing the victim to confront a specific situation or event and it’s been shown to be an effective treatment for sufferers.”

After significant blowback last year for its exclusion and revocation of an award from a sex toy company, CES 2020 is set to broaden the scope of its Health and Wellness sector to now include sex toys and up to 20 companies will be in attendance this year.

“We have to be aware that for a lot of people sexual health is just like any other part of health and wellness. This will be ‘on a one-year trial basis’,” explained Foster who said that they hadn’t handled the bad publicity around last year’s show particularly well.

There’s no doubting that CES 2020, like the shows that have preceded it, will not only highlight a broad range of innovative technologies but will explore and provide a showcase for industries that are new to the world of technology too.
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Media partners
Technology is transforming medicine, helping healthcare professionals better identify and treat illness or disease. Sensors play a vital role in numerous devices – from x-ray imaging to thermometers – and further development to achieve new capabilities, functionalities or miniaturisation promises to unlock new heights for these components.

So, where has this renewed focus come from? Filip Frederix, Head of Business Imaging at ams, credits the rise of the ‘P4’ approach to medicine. This is made up of four core pillars: preventative, participatory, predictive and personalised. Technology, medical and pharmaceutical companies alike are promoting this as a natural evolution of reactive disease care.

“To enable these models, you need to have a lot more sensors so you can monitor your health at home when you’re not even ill. Then if you look what predictive health means, it also requires some artificial intelligence and big data analysis to make sense of certain symptoms or readings. Here you need to have very accurate sensors that can be used at home.”

Preventative health, Frederix explained, will only be cost efficient if health monitoring can be carried out without frequent interactions with healthcare professionals. If patients can monitor their blood pressure at home, for example, it becomes possible to have a system where patients only need a GP appointment if they are ill, or if it is likely they will become ill. To take this a step further, health monitoring devices must be able to identify that patients require treatment at a much earlier stage. If that possibility is realised, healthcare costs could be significantly reduced.

Meeting stringent requirements
Sensor manufacturers have had to invest in research and development to ensure their products are able to meet medical requirements. Luc Buydens, Product Manager, Melexis, highlighted how medical sensors must have much higher level of accuracy than those used in other applications like industrial or air conditioning. In healthcare, sensors must have an accuracy within 0.1 or 0.2°C, compared to other applications where accuracy within 1°C is sufficient.

Buydens added that health sensors do have one benefit. To meet automotive or industrial requirements, sensors often need to be able to tolerate extreme temperatures – whether that’s as low as -40°C or as high as 250°C. Medical sensors do not need to reach those extremes, after all a reading of 250°C would indicate “much bigger problems”!

Various sensors can be used to monitor health, but certain types are being used much more widely. According to Frederix, optical sensors have been used in various medical applications due to their sensitivity and high accuracy. Advances are opening up the possibility of lab-based quality in a point of care setting. More specifically, infrared optical sensors are widely used to measure heart rate and blood oxygen levels.

Joining the dots
Medical technology developments are triggering a new era for consumer health products, and wearables is one area where innovation has flowed in that direction. Frederix explained that these are no longer used only by sports people and techies. “Wearables now also try to give you a bit more medical data, with the possibility to connect to a healthcare professional or even to a medical company. There are even smart insulin pens that give patients feedback on how well the injections have been administered. The growth of smart systems like this

New sensor capabilities are creating new possibilities for identifying, managing and treating illness. By Charlotte Hathway
will help drive accurate, integrated and cost-effective sensors."

A close interconnection between the healthcare and wearables markets will be beneficial to both sides, Overlapping development priorities could be explored through joint research projects.

Manufacturing fit-for-purpose sensor components has been critical in unlocking a lot of these possibilities. Vinau explained how ams updated certain production processes to ensure its sensor components were fit for medical applications. The company calibrates every individual sensor during its production flow, as well as considering the effects of the soldering the sensor into a PCB. He said, “The soldering process into a semiconductor device, especially into a WLCSP (wafer level chip scale package), affects the performance of the sensor. We have to ensure that, after soldering into a PCB, the accuracy is still within the required quality standards.”

Fitting sensors into new applications is also pushing sensor manufacturers to develop sensors that are cheaper and smaller than ever before, but the pressures are not only from a technical perspective. Frederix added that there are also business pressures at play. He said, “There are also infrastructural challenges that need to be overcome to build a healthcare system that allows patients to submit readings and then access treatments at home. That could mean medicines being delivered at home or in a pharmacy, for example, instead of always needing to visit a GP. There are technical challenges, but we also need a system that enables these things.”

Jose Vinau, Director of Engineering at ams, also explained that, as a semiconductor company, building the electronics below the sensor is the easy part given ams has been doing exactly that for almost 40 years. The challenge comes from “how to integrate [the sensor] into our wafer manufacturing process”. The company has found it need to “identify the sensing material – which could be chemical or a MEMS process, for example – and then integrate that into our packing process into our wafer manufacturing”.

He added this also poses challenges in terms of production testing. Existing integrated circuit undergo a test that involves charge, for example, so that process is one that is very familiar to ams. What is new with sensors used for medical applications, is the need for more tailored testing during production that can guarantee the quality. The company has already met this challenge for existing sensors, and Vinau explains that this push to improve production testing is an issue across the market.

Clinical trials
Frederix also highlighted a related challenge that comes further down the development timeline. Sensors intended for use within medical devices face further assessment before they are certified for such applications. He said the sensor “also needs to be validated in a clinical environment. If you look to our blood pressure, optical and heart rate monitoring modules, we had to [conduct] a clinical trial to prove the accuracy”.

That requirement to guarantee accuracy is echoed by Melexis’ Buydens. He said, “Authenticity and traceability is getting more and more important. Certain applications also require sensors that can be sterilised or are biocompatible.”

He explained that he means biocompatible in the sense that if the sensor needs to be worn on the skin, it should not be made from hypoallergenic materials. One example is a new device that checks blood glucose levels in patients with diabetes where a probe is inserted underneath the skin that regularly monitors blood glucose levels. In that application, biocompatibility is fundamental to its functionalities.

Development in these areas is what will help sensor manufacturers and their partners achieve the promise of healthcare that meets those four key pillars highlighted earlier. Healthcare that is preventative, participatory, predictive and personalised rests on developing cost-effective sensors that can play a vital role in treating or preventing illness and disease.
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OMC, the pioneer in optoelectronics design & manufacture, has introduced two new surface-mount LEDs, an ultra-narrow 15 degree beam LED and a 60 degree beam LED. Both new LEDs are produced by OMC in a range of package styles, beam angles and all popular LED wavelengths, plus infra-red versions. The two new devices join the SHD emitter series launched by OMC in late 2018, which includes a 30 degree output beam device that has proved very popular. Narrow beam angle LEDs are often challenging for designers to source with the move to surface-mount components. This wasn’t so much of a problem with traditional through-hole (non-surface-mount) LEDs, which are commonly produced with narrow output angles as the LED body is generally moulded around the leadframe using an optical epoxy or silicone.

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Rugged, modular MIL 83513 1.27 mm pitch connector with captive fixings suits thick PCBs and AWG24 cable.

Nicomatic UK, the leading manufacturer of high-performance interconnect systems, has announced new features for its rugged micro-connector line, the 1.27 mm pitch DTM series, which targets defense and other high-reliability applications. The MIL 83513-style connectors that require a significantly smaller footprint than the closest industry competitor now feature captive screw fixings and can be used with thicker PCBs and larger diameter cables.

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Lattice Semiconductor Corporation (NASDAQ: LSCC), the low-power programmable leader, today announced availability of performance enhancements and new and improved application reference designs for its award-winning sensAI™ solutions stack. sensAI helps OEMs develop AI and ML experiences for next-generation smart devices with power consumption measured in milliwatts. The performance enhancements include support for more compact efficient neural network models and deeper quantization support to accommodate larger models for processing higher resolution and/or faster frames-per-second images in vision applications, delivering more accurate Edge AI performance. The new reference designs let sensAI customers quickly and easily create popular AI experiences, including key phrase detection and human face recognition.

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**Mouser Announces New USB Type-C Solution Page**

Mouser Electronics, Inc., the authorized global distributor with the newest semiconductors and electronic components, is pleased to offer customers a new page dedicated to the comprehensive selection of USB Type-C products from ON Semiconductor and TE Connectivity.

USB Type-C cables introduced new design flexibility, with interchangeable cable ends, in addition to vastly improved rates of power and data transmission. Mouser’s new application-specific solution page offers a convenient resource for researching and selecting the perfect USB Type-C products for a variety of designs.

The USB Type-C solution page, now available on the Mouser Electronics website, features a wide range of products to support data and power transmission applications. The USB-C 3.0/2.0 USB Type-C Port Controller with USB-PD from ON Semiconductor is a fully autonomous controller for low-power applications that require Power Delivery, such as smartphones, laptops, tablets, and power banks.

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**Panasonic Industry Europe presents new Bluetooth 5.0 Low Energy Module PAN1740A**

The newly developed low energy PAN1740A Bluetooth 5.0 module features a compact size and fast boot time for IoT and Smart Home applications as well as Remote Controls.

Panasonic Industry launches the successor of the PAN1740B module. The new PAN1740A is the optimized version, offering a quicker boot time and supporting up to eight connections to allow greater flexibility to create more advanced applications. It can be used as a standalone application processor or as a data pump in hosted systems. The device is optimized for remote control units (RCU) requiring support for voice commands and motion gesture recognition.

The Bluetooth Low Energy firmware includes the L2CAP service layer protocols, Security Manager (SM), Attribute Protocol (ATT), the Generic Attribute Profile (GATT) and the Generic Access Profile (GAP). All profiles published by the Bluetooth SIG as well as custom profiles are supported.

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