Vidya Vikas Education Trust's

Universal College of Engineering

Approved by AICTE, DTE, Maharashtra State Goverment and Affiliated to Mumbai University

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VOLUME 03 EDITION 07

JANUARY 2021

Department Vision:

To be recognized for practicing the best teaching-learning methods to create highly competent, resourceful and self-motivated young electronics engineers for benefit of society.

Department Mission:

- To nurture engineers who can serve needs of society using new and innovative techniques in electronics.
- To improve and apply knowledge of electronics subjects through participation in different technical events.
- To enhance carrier opportunities of electronic students through industry interactions and in plant training.
- To install the passion and spirit among students to pursue higher education in electronics and entrepreneurship.

Electronic Pills - Collecting Data Inside The Body

After years of investment and development, wireless devices contained in swallowable capsules are now reaching the market. Israel-based Given Imaging and the researchers at the University of Buffalo in New York have developed ingestible capsules that record data from inside your body. These pills contain sensors or tiny cameras that collect information as they travel through the gastrointestinal tract before being excreted from the body a day or two later.

These new electronic inventions transmit information such as acidity, pressure and temperature levels or images of the esophagus and intestine to your doctor's computer for analysis.

Doctors often use invasive methods such as catheters, endoscopic instruments or radioisotopes for collecting information about the digestive tract. So device companies have been developing easier, less intrusive ways, to gather information.

Digestive diseases and disorders can include symptoms such as acid reflux, bloating, heartburn, abdominal pain, constipation, difficulty swallowing or loss of appetite.

"One of the main challenges is determining just what is happening in the stomach and intestines." says Dr. Anish A. Sheth, Director of the Gastrointestinal Motility Program at Yale-New Haven Hospital.

Doctors can inspect the colon and peer into the stomach using endoscopic instruments. But some areas cannot be easily viewed, and finding out how muscles are working can be difficult. Electronic pills are being used to measure muscle contraction, ease of passage and other factors to reveal information unavailable in the past.

Sources: givenimaging.com; buffalo.edu

Freeing humans from repetitive tasks

Located in Quebec City, Canada, the Robotiq company was set up with one aim in mind – to free human hands from repetitive tasks - and to that end it has been focused on developing a range of tools and software for the collaborative robotics (cobots) market.

Robotiq has created an easy-to-deploy set of technologies – both hardware and software - that are helping businesses to become more productive.

As Nicolas Lauzier, product manager, Robotiq explains, "Our mission is to 'free human hands'. There's so much potential lost when people are required to carry out repetitive tasks. We tackle this by simplifying the deployment of collaborative robots by providing a range of flexible tools and kits to support manufacturers, whether they are looking to automate their processes or simply want to add additional capabilities to existing robotic cells."

According to Lauzier the core technology associated with robotics, that is the hardware and the software, hasn't changed significantly in recent years and concepts like machine learning and artificial intelligence (AI) have yet to make any significant impact.

"While the mechanical and electrical controls remain familiar, what has changed is the way in which robots are deployed. We are looking at more 'human scale' deployments and are seeing far great flexibility in where and how they are used – those types of deployments have been made easier by the fact that robots are simpler to install and programme," he says.

"Robots are now far more accessible. The software running them makes them far more flexible and a lot easier to programme and understand."

Robotiq is able to supply a range of robot grippers, sensors, vision systems, and programming software.

"Today's robots don't need you to require extensive technical knowledge, which means that for many manufacturers it is possible to achieve a quick ROI," Lauzier adds. In fact collaborative robot cells equipped with the company's Plug + Play components can see a ROI within just six months.

"All of our products are designed for ease of installation and are straightforward when it comes to programming. Our technology and software can be used to accelerate robot projects and optimise the performance of a customer's cobots."

The roll-out of 5G and the greater use and deployment of sensors will make it easier to connect different devices going forward, and will help to deliver on the promises of greater connectivity that comes with Industry 4.0, believes Lauzier.

"Today, robots rarely communicate with one another, they tend to work by themselves without needing to know what is going on elsewhere. The IoT and 5G will enable remote monitoring and enhanced predictive maintenance and that's when connectivity will start to make sense."

The automation journey

Deployment is the end of the journey and taking companies through the 'journey of engaging with automation' is a critical part of the overall process, according to Lauzier. The company has developed a comprehensive range of supporting material to help engineers: eLearning modules and application coaches are available to help in setting clear expectations on feasibility and cell throughput, while expert cobot guidance is available at every stage.

Companies need help in understanding what tasks they want their cobots to undertake as well as in identifying the potential of any proposed deployments.

According to Lauzier, "For many, automation may be the end goal but how they get there is more of a challenge. We work closely with customers to help identify and understand the role of automation and the benefits it can bring. There needs to be a methodology behind the deployment and significant preparation – it's certainly not just about buying a technology.

"Our methodology is to start with simple project; where do you get the best ROI? If you start with something simple, you will accrue knowledge, it will help to build worker buy-in and you'll be able to achieve early successes."

In terms of engagement Robotiq tends to work closely with production managers, who want to improve their processes, or automation engineers, who may be looking at specific projects or applications. According to Lauzier investment in robotics only makes sense when a company is dealing with volumes but he is starting to see much greater diversification as to where deployments are taking place.

"In warehousing, for example, we are seeing demand for our palletising solutions where more flexibility is required and you see slower throughput," he explains. "Likewise with PCB assemblies, there's good potential there with the current technology."

Safety

Cobot deployments raise the issue of safety and their safe operation so, depending on the specific installation and whether the client wants cobots working alongside humans, a detailed risk assessment will be necessary.

“Where speed isn’t a prerequisite the dangers of working with cobots are minimised, so deployments don’t need to be fenced off. The footprint of the cobot will be determined by the associated task, so you may only need a small cell if you’re using cobots to pick and place individual parts,” he explains.

According to Lauzier, Robotiq is seeing a pick-up in demand from smaller businesses which is being driven by the growing interest in automation caused, in part, by the impact of Covid-19.

“When it comes to SMEs, there usually needs to be a minimal production value for automation to make sense, but it is certainly going in the direction that smaller companies are turning to automation.

“Our tools and software for the cobot market, like our AirPick, EPick and Robotiq Sanding Kits or our Bin Picking Kit, bring affordable systems to a broader spectrum of mid to high volume manufacturing and processing operations. All of these come with intuitive features that eliminate the need for expensive, complicated custom-designed solutions.

“These kits can be used to reassign cobots so you don’t need to be an expert in the field. By removing the need to customise we are able to make the process more flexible – plenty of companies have been burned in the past and too many robots have ended up in a corner of a plant, unused and unloved.”

Simpler technology and better software means that it is easier to re-assign roles to existing cobots and to redeploy them – when a change is required it can need carried out simply and just the once.

Solutions

Robotiq has a broad range of products that can easily be added to existing robotic systems and by using the company’s Plug + Play process are simple to integrate.

“When it comes to installation, however, you have to consider whether these ‘extras’ will improve the operation of the cell. Will you see measurable improvements and will the benefits outweigh the costs?,” asks Lauzier. “Adding new technology will add more complexity, so is that desirable?

“Palletising is one of the most commons robot applications and we are able to supply all the necessary components for installation – whether that’s a HD camera, software, and an electrical gripper with an integrated vacuum generator.

“Our customisable vacuum grippers can be used across a wide range of industrial applications, they are fast to install and can handle objects of varying sizes, shapes, materials and weights, while our Force CoPilot software can be used to automate more advanced force-sensitive applications and it’s possible to programme complex robotic movements in a matter minutes,” explains Lauzier.

Robotiq is able to provide a complete solution for locating, picking, handling, and placing flat and cylindrical parts – offering a rapid set-up. Compatible with Universal Robots, the company’s kits are being used by appliance manufacturers, automotive components suppliers, general industry, and by suppliers of metal and plastic products. “Our Plug + Play solutions, kits and software solutions are intended to lower the barriers to entry but also allow companies to entertain the idea of automation in areas that up until now were considered too complex of costly,” says Lauzier.

Author

Neil Tyler

Time holds the key to 6G

5G is still in the early stages of its rollout but the attention in R&D is now on the next generation to come, even if its launch may be some way off.

At the VLSI Symposia 2020 in June, Takehiro Nakamura, senior VP and general manager of 5G Laboratories at NTT Docomo, said he expects 6G to arrive a decade from now. But geopolitics driven by the US even with a change in administration may play a role in speeding up the development of follow-ons to 5G.

In an online seminar earlier this autumn organised by Stanford University's Institute for Human-Centered Artificial Intelligence (HAI) group, Mike Brown, director of the US Defense Innovation Unit, pointed to the way in which Chinese suppliers had overtaken telecom suppliers based in the west: "On 5G, we were asleep at the switch: we've let telecoms leadership leave the US."

Brown said that country had two choices. One was to embrace technologies that would make it easier to swap hardware in and out of the networks, an approach that the Open-RAN set of standards were created to allow. The other is "to leapfrog and go to 6G". In October, the Alliance for Telecommunications Industry Solutions (ATIS) formed the North America-focused Next G Alliance that will run in parallel with efforts in Europe and Asia.

The situation may resemble the prelude to 4G, when some suppliers rolled out additions to 3G that they claimed offered the performance boost the new generation would provide, some with regional tweaks. Even before this fragmentation, the 6G process was likely to follow the one set in the 4G deliberations. "With 4G there was no single representative technology: it was a combination of technologies, which was the case for 5G also. We think 6G will be defined similarly: a combination of technologies for big performance gains," Nakamura says.

Many of the design targets for 6G look similar to those that drove the 5G effort: even higher data rates but at lower latency and with lower energy consumption per bit. Though applications such as augmented and virtual reality remain niches, technologists such as Nakamura look to those areas as being drivers for the additional performance. The Covid-19 pandemic may have a hand in driving these technologies forward as artificial reality applications will support greater use of teleworking. "Large amount of information will need to be transferred between physical space and cyberspace," he says.

Change is already happening

Some of the changes that will be needed for 6G are already happening. Nakamura says machine learning is likely to become ubiquitous in cellular. "We think AI can be used to improve system performance: AI and machine learning should be integrated into everything."

Some companies have already incorporated machine learning into their offerings. Ceva, for example, applied the technique in its PentaG IP cores for 5G a couple of years ago: to handle tasks such as link adaptation on the basis that the many parameters, that affect signal quality, have become too difficult to model well conventionally. Training handsets and base stations to find good settings for different conditions made more sense in Ceva's view. For technologists such as Nakamura, AI would help make higher-level decisions in the future, such as switching between different radio interfaces to maximise throughput. The expectation is that rather than being divided into discrete cells, the future topologies will use extensive overlapping with beamforming driven by MIMO antenna arrays used to direct the signals.

Although AI can help improve performance, radio designers are looking at increasingly exotic mechanisms to try to push wireless data rates towards the 1Tbit/s target researchers such as Professor Gerhard Fettweis of the Technical University of Dresden see as feasible by the mid-2030s. Similar to 5G, one path is to push even higher in transmission frequency.

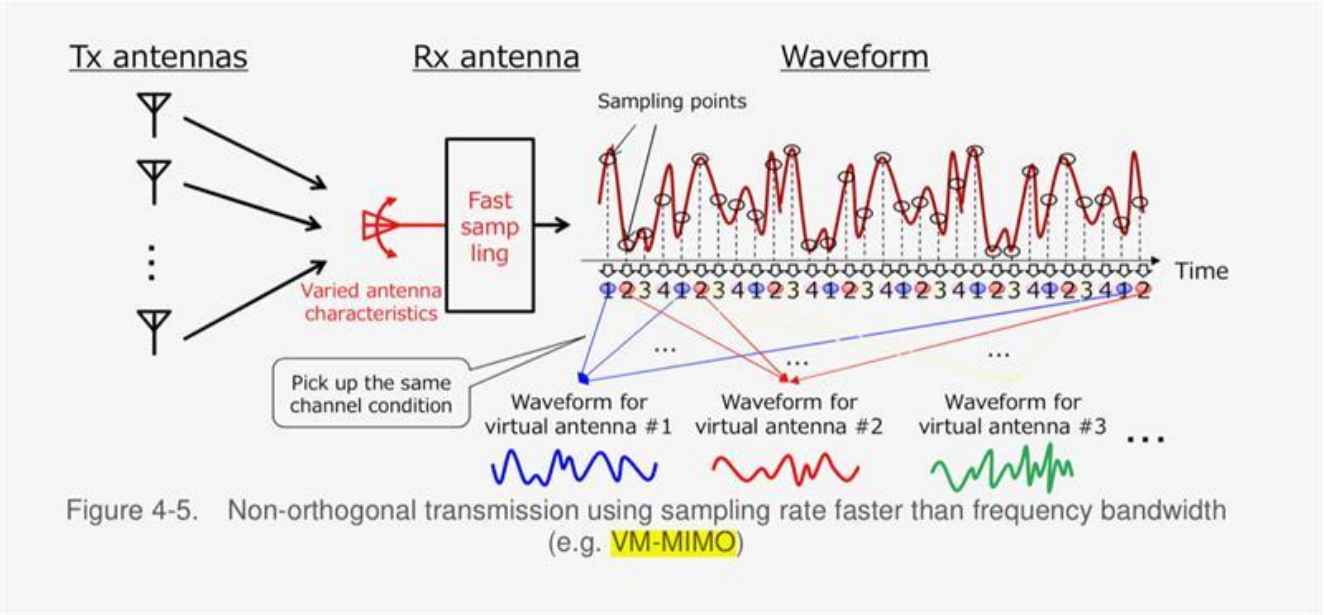

Figure 4-5. Non-orthogonal transmission using sampling rate faster than frequency bandwidth (e.g. VM-MIMO)

The use of millimetre-wave transmission lags the core 5G standard. But Professor Ted Rappaport of the NYU Tandon School of Engineering who did extensive work on that frequency range for 5G has moved onto the terahertz range. It is a range presents far tougher challenges not least because conventional electronics fare badly in that range and water absorption limits the range of transmission. It is roughly an order of magnitude worse at 250GHz than at the 26GHz assigned by numerous countries to millimetre-wave 5G. But scientists like Rappaport and Fettweis are optimistic. Fettweis points to processes such as FD-SOI as candidates for terahertz transceivers. Two years ago, a group working at the University of Wuppertal demonstrated a detector built using GlobalFoundries' 22nm FDSOI technology that operated at more than 800GHz. One big advantage of terahertz operation is that, past 80GHz, the antenna can be integrated into the package of a transceiver IC, which eases the design of MIMO arrays that would be used to steer the beam towards a receiver. Even with FD-SOI, which can deliver better power consumption for RF designs that conventional silicon processes, power consumption remains one of the big challenges in interface design. Simply scaling up today's analogue-digital converter (ADC) circuitry to handle terahertz frequencies is not going to work. According to Fettweis, taking an ADC that consumes 100mW at 1GHz, its terahertz equivalent could pull down a full watt of power.

Novel approaches

At the autumn public meeting of the IEEE International Roadmap for Devices and Systems (IRDS) group, C Michael Garner, "technology consultant and a lead author of the outside-system connectivity chapter of the IRDS", said 6G provides an opportunity to investigate novel approaches to signal conversion.

One direction being pursued by a variety of teams is to take advantage of the way in which CMOS processes are far better at fast switching than detecting subtle changes in voltage, a factor that can streamline the traditional high-speed but large and power-hungry flash ADC. Garner highlighted one example of a circuit developed by a group at NTT earlier this year: "A 6bit converter uses just 10 dynamic comparators rather than the 63 of conventional ADCs," he said.

An evolution of work by Mediatek demonstrated at the 2012 VLSI Symposium, this and similar time-domain interpolation take advantage of the way in which dynamic comparators take longer to settle if the voltage they sense is close to the reference. Much smaller and simpler NOR or NAND switches can detect the difference in time and use that to interpolate between the coarse discrete levels registered by a small number of front-end comparators.

As well as applying four-level interpolation, the NTT circuit added selective activation to cut power consumption to yield a 6GHz circuit that consumes just over 15mW.

6G protocols may dispense with the need to detect voltage changes at all in the incoming analogue signal and even overturn the conventional wisdom of obeying traditional wisdom on bandwidth limitations such as the Nyquist frequency.

Faster-than-Nyquist (FTN) signalling was considered for 5G and is now a prime candidate for going beyond it. Conventional signals keep the symbol rate below the Nyquist frequency to avoid successive bits from interfering with each other. FTN scraps that in favour of a higher signalling rate coupled with more intensive signal processing to try to minimise the inter-symbol interference.

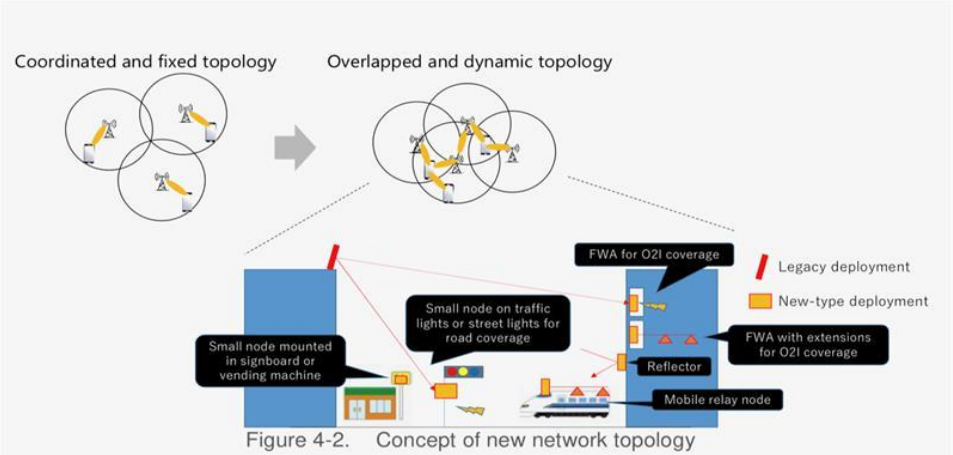

Figure 4-2. Concept of new network topology

Fettweis and colleagues have proposed what they call a zero-crossing time-based modulation (ZXM) scheme on the basis that CMOS can handle the oversampling requirements of FTN signalling. "This is being investigated by a number of companies. We're told it won't necessarily handle all RF communications but is promising for the future," Garner claims.