DEPERTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Tele Electro

NEWSLETTER

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DHANEKULA INSTITUTE OF ENGINEERING AND TECHNOLOGY :: GANGURU

DHANEKULA INSTITUTE OF ENGINEERING & TECHNOLOGY::GANGURU

Institute Vision

Pioneering Professional Education through Quality.

Institute Mission

1. Quality Education through state-of-art infrastructure, laboratories and committed staff.
2. Moulding Students as proficient, competent, and socially responsible engineering personnel with ingenious intellect.
3. Involving faculty members and students in research and development works for betterment of society.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision

- Pioneering Electronics and Communication Engineering Education & Research to Elevate Rural Community

Mission

- Imparting professional education endowed with ethics and human values to transform students to be competent and committed electronics engineers.
- Adopting best pedagogical methods to maximize knowledge transfer.
- Having adequate mechanisms to enhance understanding of theoretical concepts through practice.
- Establishing an environment conducive for lifelong learning and entrepreneurship development.
- To train as effective innovators and deploy new technologies for service of society.

Principal's Message

Dear Parents and Students,
It is with great pleasure that I welcome you to our College (DIET) Newsletter.

As Principal I am hugely impressed by the commitment of the college and the staff in providing an excellent all-round education for our students with our state of the art facilities. We as a team working together, strongly promote the zeal towards academic achievement among our students. The cultural, sports and other successes of all our students and staff are also proudly celebrated together. I congratulate the staff and students who brought latest technologies and concepts onto the day to day teaching learning platform. As long as our ideas are expressed and thoughts kindled, we can be sure of learning, as everything begins with an idea.

I appreciate every student who shared the joy of participation in co-curricular and extracurricular activities along with their commitment to curriculum. That little extra we do, is the icing on the cake. 'Do more than belong – participate. Do more than care – help. Do more than believe – practice. Do more than be fair – be kind. Do more than forgive – forget. Do more than dream – work.'

With a long and rewarding history of achievement in education behind us, our DIET community continues to move forward together with confidence, pride and enthusiasm.

I hope you enjoy your visit to the website, and should you wish to contact us, please find details at the www.diet.ac.in

Yours in Education,

Dr. Ravi Kadiyala
Principal

HOD's Message

The Department of Electronics & Communication Engineering (ECE) has consistently maintained an exemplary academic record. The greatest asset of the department is its highly motivated and learned faculty. The available diversity of expertise of the faculty with the support of the other staff prepares the students to work in global multicultural environment. The graduates of the Electronics & Communication Stream have been selected by some of the world's leading corporations & as well as by most of the leading Indian counter parts. We hope that we will continue to deliver our best to serve the society and mankind. It is also expected that our students will continue to pass-on the skills which they have developed during their stay at this department to whole of the world for a better society.

Dr.G.L.Madhumati
Professor & HOD
Dept. of ECE
Dhanekula Institute of Engineering & Technology

Editor's Note

Dear Readers,

It gives us great pleasure to bring you the fourth issue of **Tele-Electro** for the academic year 2020-21, the Department newsletter of Dhanekula Institute of Engineering & Technology, Ganguru.

The name and fame of an institute depends on the caliber and achievements of the students and teachers. The role of a teacher is to be a facilitator in nurturing the skills and talents of students. This Newsletter is a platform to exhibit the literary skills and innovative ideas of teachers and students. **Tele-Electro** presents the achievements of students and contributions of teachers.

We profusely thank the management for giving support and encouragement and a free hand in this endeavour. Last but not the least we are thankful to all the authors who have sent their articles. We truly hope that the pages that follow will make an interesting read.

Mr. N Nagaraju
Faculty Member

P.Sai Bhavana
Student Coordinator

P.Harshita
Student Coordinator

Student Articles

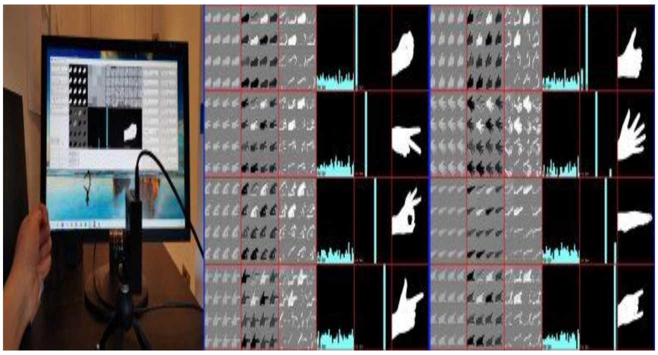
Intelligent Cameras That Can Learn and Understand What They Are Seeing

Intelligent cameras could be one step closer thanks to a research collaboration between the Universities of Bristol and Manchester who have developed cameras that can learn and understand what they are seeing.

Roboticists and artificial intelligence (AI) researchers know there is a problem in how current systems sense and process the world. Currently they are still combining sensors, like digital cameras that are designed for recording images, with computing devices like graphics processing units (GPUs) designed to accelerate graphics for video games.

This means AI systems perceive the world only after recording and transmitting visual information between sensors and processors. But many things that can be seen are often irrelevant for the task at hand, such as the detail of leaves on roadside trees as an autonomous car passes by. However, at the moment all this information is captured by sensors in meticulous detail and sent clogging the system with irrelevant data, consuming power and taking processing time. A different approach is necessary to enable efficient vision for intelligent machines.

Two papers from the Bristol and Manchester collaboration have shown how sensing and learning can be combined to create novel cameras for AI systems.



A Convolutional Neural Network (CNN) on the SCAMP-5D vision system classifying hand gestures at 8,200 frames per second. Credit: University of Bristol, 2020

Walterio Mayol-Cuevas, Professor in Robotics, Computer Vision and Mobile Systems at the University of Bristol and principal investigator (PI), commented: "To create efficient perceptual systems we need to push the boundaries beyond the ways we have been following so far.

"We can borrow inspiration from the way natural systems process the visual world — we do not perceive everything — our eyes and our brains work together to make sense of the world and in some cases, the eyes themselves do processing to help the brain reduce what is not relevant."

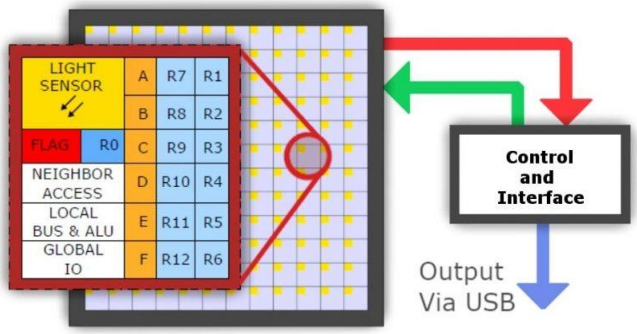
SCAMP-5d vision system. Credit: The University of Manchester, 2020

This is demonstrated by the way the frog's eye has detectors that spot fly-like objects, directly at the point where the images are sensed.

The papers, one led by Dr. Laurie Bose and the other by Yanan Liu at Bristol, have revealed two refinements towards this goal. By implementing Convolutional Neural Networks (CNNs), a form of AI algorithm for enabling visual understanding, directly on the image plane. The CNNs the team has developed can classify frames at thousands of times per second, without ever having to record these images or send them down the processing pipeline. The researchers considered demonstrations of classifying handwritten numbers, hand gestures and even classifying plankton.

The research suggests a future with intelligent dedicated AI cameras — visual systems that can simply send high-level information to the rest of the system, such as the type of object or event taking place in front of the camera. This approach would make systems far more efficient and secure as no images need be recorded.

The work has been made possible thanks to the SCAMP architecture developed by Piotr Dudek, Professor of Circuits and Systems and PI from the University of Manchester, and his team. The SCAMP is a camera-processor chip that the team describes as a Pixel Processor Array (PPA). A PPA has a processor embedded in each and every pixel which can communicate with each other to process in truly parallel form. This is ideal for CNNs and vision algorithms.



SCAMP-5d's hardware architecture. It incorporates a 256 x 256 PPA array of pixel-processors, each containing light sensor, local memory registers and other functional components. Credit: The University of Manchester, 2020

Professor Dudek said: "Integration of sensing, processing and memory at the pixel level is not only enabling high-performance, low-latency systems, but also promises low-power, highly efficient hardware.

"SCAMP devices can be implemented with footprints similar to current camera sensors, but with the ability to have a general-purpose massively parallel processor right at the point of image capture."

Dr. Tom Richardson, Senior Lecturer in Flight Mechanics, at the University of Bristol and a member of the project has been integrating the SCAMP architecture with lightweight drones.
He explained: "What is so exciting about these cameras is not only the newly emerging machine learning capability, but the speed at which they run and the lightweight configuration. They are absolutely ideal for high speed, highly agile aerial platforms that can literally learn on the fly!"

The research, funded by the Engineering and Physical Sciences Research Council (EPSRC), has shown that it is important to question the assumptions that are out there when AI systems are designed. And things that are often taken for granted, such as cameras, can and should be improved towards the goal of more efficient intelligent machines.

Article Collected by
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178T1A0493
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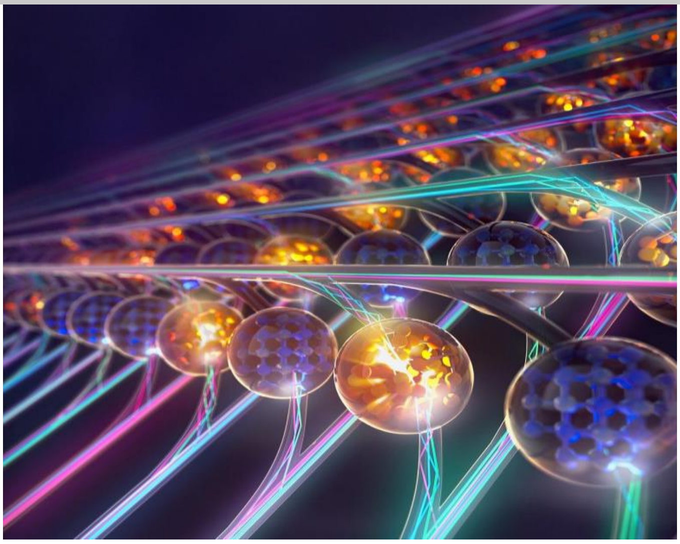
AI Boosted by Parallel Convolutional Light-Based Processors

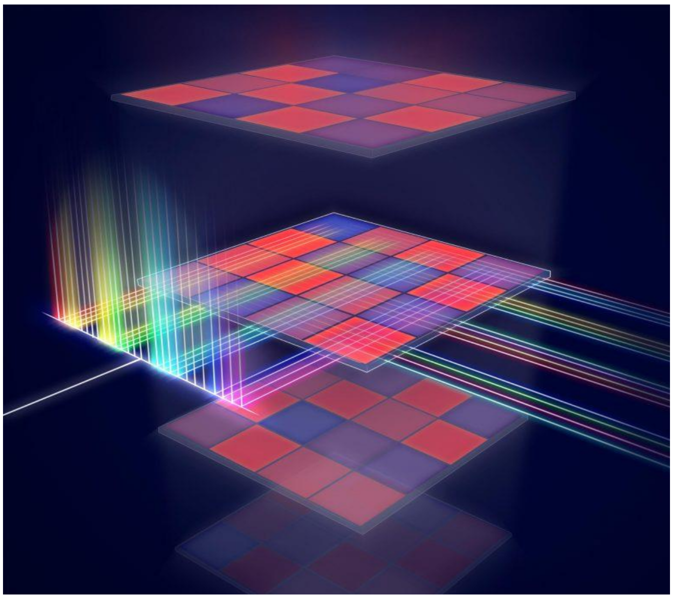


Schematic representation of a processor for matrix multiplications which runs on light. Credit: University of Oxford

The exponential growth of data traffic in our digital age poses some real challenges on processing power. And with the advent of machine learning and AI in, for example, self-driving vehicles and speech recognition, the upward trend is set to continue. All this places a heavy burden on the ability of current computer processors to keep up with demand.

Now, an international team of scientists has turned to light to tackle the problem. The researchers developed a new approach and architecture that combines processing and data storage onto a single chip by using light-based, or "photonic" processors, which are shown to surpass conventional electronic chips by processing information much more rapidly and in parallel.

The scientists developed a hardware accelerator for so-called matrix-vector multiplications, which are the backbone of neural networks (algorithms that simulate the human brain), which themselves are used for machine-learning algorithms. Since different light wavelengths (colors) don't interfere with each other, the researchers could use multiple wavelengths of light for parallel calculations. But to do this, they used another innovative technology, developed at EPFL, a chip-based "frequency comb," as a light source.



Schematic representation of a processor for matrix multiplications which runs on light. Credit: University of Oxford

"Our study is the first to apply frequency combs in the field of artificial neural networks," says Professor Tobias Kippenberg at EPFL, one the study's leads. Professor Kippenberg's research has pioneered the development of frequency combs. "The frequency comb provides a variety of optical wavelengths that are processed independently of one another in the same photonic chip."

"Light-based processors for speeding up tasks in the field of machine learning enable complex mathematical tasks to be processed at high speeds and throughputs," says senior co-author Wolfram Pernice at Münster University, one of the professors who led the research. "This is much faster than conventional chips which rely on electronic data transfer, such as graphic cards or specialized hardware like TPU's (Tensor Processing Unit)."

After designing and fabricating the photonic chips, the researchers tested them on a neural network that recognizes of hand-written numbers. Inspired by biology, these networks are a concept in the field of machine learning and are used primarily in the processing of image or audio data. "The convolution operation between input data and one or more filters — which can identify edges in an image, for example, are well suited to our matrix architecture," says Johannes Feldmann, now based at the University of Oxford Department of Materials. Nathan Youngblood (Oxford University) adds: "Exploiting wavelength multiplexing permits higher data rates and computing densities, i.e. operations per area of processer, not previously attained."

"This work is a real showcase of European collaborative research," says David Wright at the University of Exeter, who leads the EU project FunComp, which funded the work. "Whilst every research group involved is world-leading in their own way, it was bringing all these parts together that made this work truly possible."

The study is published in *Nature* this week, and has far-reaching applications: higher simultaneous (and energy-saving) processing of data in artificial intelligence, larger neural networks for more accurate forecasts and more precise data analysis, large amounts of clinical data for diagnoses, enhancing rapid evaluation of sensor data in self-driving vehicles, and expanding cloud computing infrastructures with more storage space, computing power, and applications software.

Article Collected by
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178T1A04A8
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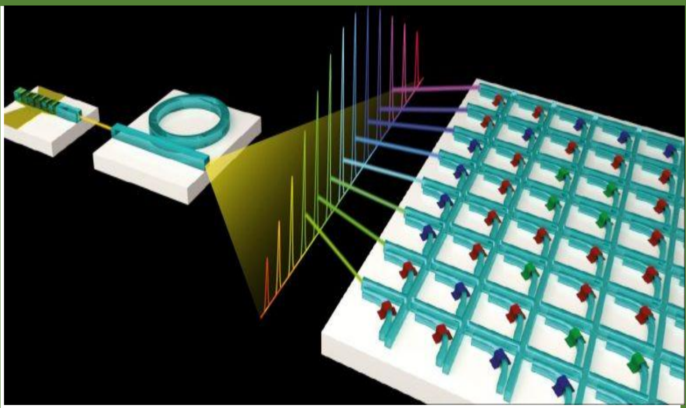
Light-Based Processor Chips Advance Machine Learning



Schematic representation of a processor for matrix multiplications which runs on light. Together with an optical frequency comb, the waveguide crossbar array permits highly parallel data processing. Credit: WWU/AG Pernice

International team of researchers uses photonic networks for pattern recognition.

In the digital age, data traffic is growing at an exponential rate. The demands on computing power for applications in artificial intelligence such as pattern and speech recognition in particular, or for self-driving vehicles, often exceeds the capacities of conventional computer processors. Working together with an international team, researchers at the University of Münster are developing new approaches and process architectures that can cope with these tasks extremely efficiently. They have now shown that so-called photonic processors, with which data is processed by means of light, can process information much more rapidly and in parallel — something electronic chips are incapable of doing. The results have been published in the journal *Nature*.

Background and methodology

Light-based processors for speeding up tasks in the field of machine learning enable complex mathematical tasks to be processed at enormously fast speeds (10^{12} -10^{15} operations per second). Conventional chips such as graphic cards or specialized hardware like Google's TPU (Tensor Processing Unit) are based on electronic data transfer and are much slower. The team of researchers led by Prof. Wolfram Pernice from the Institute of Physics and the Center for Soft Nanoscience at the University of Münster implemented a hardware accelerator for so-called matrix multiplications, which represent the main processing load in the computation of neural networks. Neural networks are a series of algorithms which simulate the human brain. This is helpful, for example, for classifying objects in images and for speech recognition.

The researchers combined the photonic structures with phase-change materials (PCMs) as energy-efficient storage elements. PCMs are usually used with DVDs or BluRay discs in optical data storage. In the new processor, this makes it possible to store and preserve the matrix elements without the need for an energy supply. To carry out matrix multiplications on multiple data sets in parallel, the Münster physicists used a chip-based frequency comb as a light source. A frequency comb provides a variety of optical wavelengths which are processed independently of one another in the same photonic chip. As a result, this enables highly parallel data processing by calculating on all wavelengths simultaneously – also known as wavelength multiplexing. "Our study is the first one to apply frequency combs in the field of artificially neural networks," says Wolfram Pernice.

In the experiment the physicists used a so-called convolutional neural network for the recognition of handwritten numbers. These networks are a concept in the field of machine learning inspired by biological processes. They are used primarily in the processing of image or audio data, as they currently achieve the highest accuracies of classification. "The convolutional operation between input data and one or more filters – which can be a highlighting of edges in a photo, for example – can be transferred very well to our matrix architecture," explains Johannes Feldmann, the lead author of the study. "Exploiting light for signal transference enables the processor to perform parallel data processing through wavelength multiplexing, which leads to a higher computing density and many matrix multiplications being carried out in just one timestep. In contrast to traditional electronics, which usually work in the low GHz range, optical modulation speeds can be achieved with speeds up to the 50 to 100 GHz range." This means that the process permits data rates and computing densities, i.e. operations per area of processor, never previously attained.

The results have a wide range of applications. In the field of artificial intelligence, for example, more data can be processed simultaneously while saving energy. The use of larger neural networks allows more accurate, and hitherto unattainable, forecasts and more precise data analysis. For example, photonic processors support the evaluation of large quantities of data in medical diagnoses, for instance in high-resolution 3D data produced in special imaging methods. Further applications are in the fields of self-driving vehicles, which depend on fast, rapid evaluation of sensor data, and of IT infrastructures such as cloud computing which provide storage space, computing power or applications software.

Article Collected by
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MIT Deep-Learning Algorithm Finds Hidden Warning Signals in Measurements Collected Over Time

MIT researchers have developed a deep learning-based algorithm to detect anomalies in time series data. Credit: MIT News

A new deep-learning algorithm could provide advanced notice when systems — from satellites to data centers — are falling out of whack.

When you're responsible for a multimillion-dollar satellite hurtling through space at thousands of miles per hour, you want to be sure it's running smoothly. And time series can help.

A time series is simply a record of a measurement taken repeatedly over time. It can keep track of a system's long-term trends and short-term blips. Examples include the infamous Covid-19 curve of new daily cases and the Keeling curve that has tracked atmospheric carbon dioxide concentrations since 1958. In the age of big data, "time series are collected all over the place, from satellites to turbines," says Kalyan Veeramachaneni. "All that machinery has sensors that collect these time series about how they're functioning."

But analyzing those time series, and flagging anomalous data points in them, can be tricky. Data can be noisy. If a satellite operator sees a string of high temperature readings, how do they know whether it's a harmless fluctuation or a sign that the satellite is about to overheat?

That's a problem Veeramachaneni, who leads the Data-to-AI group in MIT's Laboratory for Information and Decision Systems, hopes to solve. The group has developed a new, deep-learning-based method of flagging anomalies in time series data. Their approach, called TadGAN, outperformed competing methods and could help operators detect and respond to major changes in a range of high-value systems, from a satellite flying through space to a computer server farm buzzing in a basement.

The research will be presented at this month's IEEE BigData conference. The paper's authors include Data-to-AI group members Veeramachaneni, postdoc Dongyu Liu, visiting research student Alexander Geiger, and master's student Sarah Alnegheimish, as well as Alfredo Cuesta-Infante of Spain's Rey Juan Carlos University.

High stakes

For a system as complex as a satellite, time series analysis must be automated. The satellite company SES, which is collaborating with Veeramachaneni, receives a flood of time series from its communications satellites — about 30,000 unique parameters per spacecraft. Human operators in SES' control room can only keep track of a fraction of those time series as they blink past on the screen. For the rest, they rely on an alarm system to flag out-of-range values. "So they said to us, 'Can you do better?'" says Veeramachaneni. The company wanted his team to use deep learning to analyze all those time series and flag any unusual behavior.

The stakes of this request are high: If the deep learning algorithm fails to detect an anomaly, the team could miss an opportunity to fix things. But if it rings the alarm every time there's a noisy data point, human reviewers will waste their time constantly checking up on the algorithm that cried wolf. "So we have these two challenges," says Liu. "And we need to balance them."

Rather than strike that balance solely for satellite systems, the team endeavored to create a more general framework for anomaly detection — one that could be applied across industries. They turned to deep-learning systems called generative adversarial networks (GANs), often used for image analysis.

A GAN consists of a pair of neural networks. One network, the "generator," creates fake images, while the second network, the "discriminator," processes images and tries to determine whether they're real images or fake ones produced by the generator. Through many rounds of this process, the generator learns from the discriminator's feedback and becomes adept at creating hyper-realistic fakes. The technique is deemed "unsupervised" learning, since it doesn't require a prelabeled dataset where images come tagged with their subjects. (Large labeled datasets can be hard to come by.)

The team adapted this GAN approach for time series data. "From this training strategy, our model can tell which data points are normal and which are anomalous," says Liu. It does so by checking for discrepancies — possible anomalies — between the real time series and the fake GAN-generated time series. But the team found that GANs alone weren't sufficient for anomaly detection in time series, because they can fall short in pinpointing the real time series segment against which the fake ones should be compared. As a result, "if you use GAN alone, you'll create a lot of false positives," says Veeramachaneni.

To guard against false positives, the team supplemented their GAN with an algorithm called an autoencoder — another technique for unsupervised deep learning. In contrast to GANs' tendency to cry wolf, autoencoders are more prone to miss true anomalies. That's because autoencoders tend to capture too many patterns in the time series, sometimes interpreting an actual anomaly as a harmless fluctuation — a problem called "overfitting." By combining a GAN with an autoencoder, the researchers crafted an anomaly detection system that struck the perfect balance: TadGAN is vigilant, but it doesn't raise too many false alarms.

Standing the test of time series

Plus, TadGAN beat the competition. The traditional approach to time series forecasting, called ARIMA, was developed in the 1970s. "We wanted to see how far we've come, and whether deep learning models can actually improve on this classical method," says Alnegheimish.

The team ran anomaly detection tests on 11 datasets, pitting ARIMA against TadGAN and seven other methods, including some developed by companies like Amazon and Microsoft. TadGAN outperformed ARIMA in anomaly detection for eight of the 11 datasets. The second-best algorithm, developed by Amazon, only beat ARIMA for six datasets.

Alnegheimish emphasized that their goal was not only to develop a top-notch anomaly detection algorithm, but also to make it widely useable. "We all know that AI suffers from reproducibility issues," she says. The team has made TadGAN's code freely available, and they issue **periodic updates**. Plus, they developed a benchmarking system for users to compare the performance of different anomaly detection models.

"This benchmark is open source, so someone can go try it out. They can add their own model if they want to," says Alnegheimish. "We want to mitigate the stigma around AI not being reproducible. We want to ensure everything is sound."

Veeramachaneni hopes TadGAN will one day serve a wide variety of industries, not just satellite companies. For example, it could be used to monitor the performance of computer apps that have become central to the modern economy. "To run a lab, I have 30 apps. Zoom, Slack, Github — you name it, I have it," he says. "And I'm relying on them all to work seamlessly and forever." The same goes for millions of users worldwide.

TadGAN could help companies like Zoom monitor time series signals in their data center — like CPU usage or temperature — to help prevent service breaks, which could threaten a company's market share. In future work, the team plans to package TadGAN in a user interface, to help bring state-of-the-art time series analysis to anyone who needs it.

Article Collected by
Sai Bhavana
198T1A04B1
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Silicon Waveguides Move Us Closer to Blazing Fast Light-Based Computer Circuits

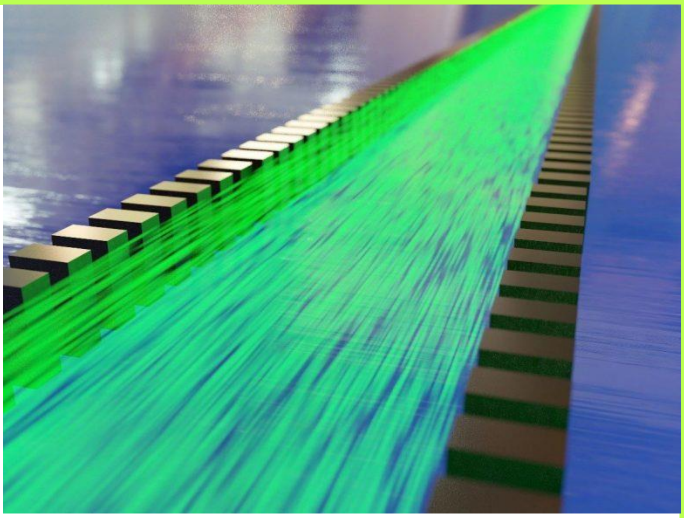


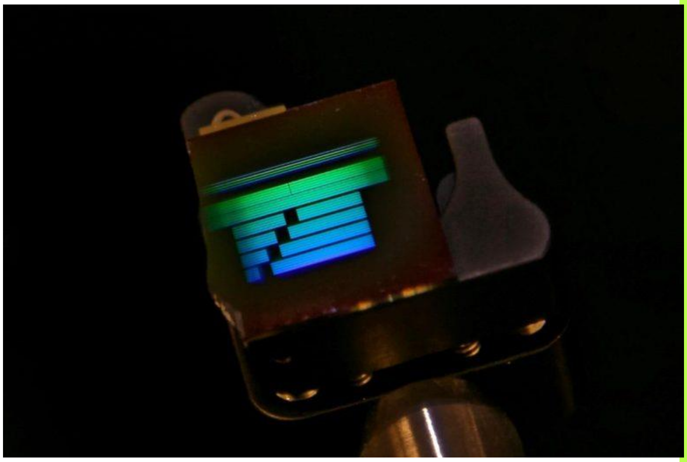
Illustration of a pair of silicon high contrast gratings that can be used to guide visible light on a chip with low losses despite large absorption by the silicon material. Credit: Urbonas, D., Mahrt, R.F. and Stöferle

For decades, the speed of our computers has been growing at a steady pace. The processor of the first IBM PC released 40 years ago, operated at a rate of roughly 5 million clock cycles per second (4.77 MHz). Today, the processors in our personal computers run around 1000 times faster.

However, with current technology, they're not likely to get any faster than that.

For the last 15 years, the clock rate of single processor cores has stalled at a few Gigahertz (1 Gigahertz = 1 billion clock cycles per second). And the old and tested approach of cramming ever more transistors on a chip will no longer help in pushing that boundary. At least not without breaking the bank in terms of power consumption.

A way out of the stagnation could come in the form of optical circuits in which the information is encoded in light rather than electronics. In 2019, an IBM Research team together with partners from academia built the world's first ultrafast all-optical transistor capable of operating at room temperature. The team now follows up with another piece of the puzzle, a silicon waveguide that links up such transistors, carrying light between them with minimal losses.



Silicon test chip with high contrast grating waveguides. Credit: Urbonas, D., Mahrt, R.F. and Stöferle, T.

Wiring up the transistors of an optical circuit with silicon waveguides is an important requirement to make compact, highly integrated chips. That's because it's easier to place other needed components such as electrodes in its close vicinity if the waveguide is made of silicon. The techniques used for that purpose have been refined for decades in the semiconductor industry.

However, silicon being a notoriously strong absorber of visible light makes it great for capturing sunlight in a photovoltaics panels but a poor choice for a waveguide where light absorption means signal loss.

Making a fence to confine light

So, the IBM researchers thought of ways to use the mature silicon technology while circumventing the absorption issue. Their solution involves nanostructures called high contrast gratings with a striking behavior that some of the team members had already discovered over 10 years ago, albeit for another application.

A high contrast grating consists of nanometer sized "posts" lined up to form a sort of fence that prevents light from escaping. The posts are 150 nanometers in diameter and are spaced in such a way that light passing through the posts interferes destructively with light passing between posts. Destructive interference is a well-known phenomenon by which waves oscillating out of sync cancel each other out at a point in space. It affects light, which is an electromagnetic wave, just as it does sound and other types of wave. In this case, the destructive interference makes sure that no light can "leak" through the grating. Instead, most of the light gets reflected back inside the waveguide. The IBM researchers also showed that absorption of light inside the posts themselves is minimal. All this together translates in losses of only 13 percent along a light travel path of 1 millimeter inside the waveguide. For comparison: Along already only one hundredth of that distance (10 micrometers) in a pure silicon waveguide without the gratings, the losses would amount to 99.7 percent.

Simulations for precise grating design

On its face, the basic idea behind the high contrast gratings looks simple. However, it was indeed surprising when the researchers found out for the first time that they could keep light from being absorbed by a "dark" material like silicon.

Back in 2010, when they first observed the grating effect, it occurred in a laser microcavity which helped because the light amplification by the laser would compensate for the losses. Also, they had the light hitting the gratings at almost 90 degrees which is a sweet spot for the grating effect to kick in. But keeping the losses low in a waveguide without the benefit of the laser gain and at almost grazing light incidence was much more challenging.

To make sure their grating design would be up to the task, the team ran simulations showing how light propagation inside the waveguide would change with varying grating dimensions. They found out that the grating would provide efficient guiding of light over a broad band of wavelengths. All they needed to do was choose the right spacing between the grating posts and make the posts themselves to the right thickness within a precision margin of 15 nanometers. Using a standard silicon photonics fabrication process, those requirements proved manageable. In fact, the experiments confirmed what the simulations had predicted in terms of low loss for visible light in the range between 550 and 650 nanometers.

Potential benefits for optical circuits and beyond

The team found some evidence through simulations that this design can be used to make not only straight waveguides but also guide the light around corners. But they haven't yet run the experiments to confirm this idea. Even if it proves feasible, some further optimization will be needed to keep the additional losses low in that case. Looking ahead, a next step will be to engineer the efficient coupling of the light out of the waveguides into other components. That will be a crucial step in the team's multi-year exploratory research project with the goal of integrating the all-optical transistors they demonstrated in 2019 into integrated circuits capable of performing simple logic operations.

The team believes that their low-loss silicon waveguide could enable new photonic chip designs for use in biosensing and other applications that rely on visible light. It could also benefit the engineering of more efficient optical components such as lasers and modulators widely used in telecommunications.

Article Collected by
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III ECE

Faculty Articles

MIT System Brings Deep Learning AI to "Internet of Things" Devices

MIT researchers have developed a system, called MCUNet, that brings machine learning to microcontrollers. The advance could enhance the function and security of devices connected to the Internet of Things (IoT). Credit: MIT

Advance could enable artificial intelligence on household appliances while enhancing data security and energy efficiency.

Deep learning is everywhere. This branch of artificial intelligence curates your social media and serves your Google search results. Soon, deep learning could also check your vitals or set your thermostat. MIT researchers have developed a system that could bring deep learning neural networks to new — and much smaller — places, like the tiny computer chips in wearable medical devices, household appliances, and the 250 billion other objects that constitute the "internet of things" (IoT).

The system, called MCUNet, designs compact neural networks that deliver unprecedented speed and accuracy for deep learning on IoT devices, despite limited memory and processing power. The technology could facilitate the expansion of the IoT universe while saving energy and improving data security.

The research will be presented at next month's Conference on Neural Information Processing Systems. The lead author is Ji Lin, a PhD student in Song Han's lab in MIT's Department of Electrical Engineering and Computer Science. Co-authors include Han and Yujun Lin of MIT, Wei-Ming Chen of MIT and National University Taiwan, and John Cohn and Chuang Gan of the MIT-IBM Watson AI Lab.

The Internet of Things

The IoT was born in the early 1980s. Grad students at Carnegie Mellon University, including Mike Kazar '78, connected a Cola-Cola machine to the internet. The group's motivation was simple: laziness. They wanted to use their computers to confirm the machine was stocked before trekking from their office to make a purchase. It was the world's first internet-connected appliance. "This was pretty much treated as the punchline of a joke," says Kazar, now a Microsoft engineer. "No one expected billions of devices on the internet."

Since that Coke machine, everyday objects have become increasingly networked into the growing IoT. That includes everything from wearable heart monitors to smart fridges that tell you when you're low on milk. IoT devices often run on microcontrollers — simple computer chips with no operating system, minimal processing power, and less than one thousandth of the memory of a typical smartphone. So pattern-recognition tasks like deep learning are difficult to run locally on IoT devices. For complex analysis, IoT-collected data is often sent to the cloud, making it vulnerable to hacking.

"How do we deploy neural nets directly on these tiny devices? It's a new research area that's getting very hot," says Han. "Companies like Google and ARM are all working in this direction." Han is too.

With MCUNet, Han's group codesigned two components needed for "tiny deep learning" — the operation of neural networks on microcontrollers. One component is TinyEngine, an inference engine that directs resource management, akin to an operating system. TinyEngine is optimized to run a particular neural network structure, which is selected by MCUNet's other component: TinyNAS, a neural architecture search algorithm.

System-algorithm codesign

Designing a deep network for microcontrollers isn't easy. Existing neural architecture search techniques start with a big pool of possible network structures based on a predefined template, then they gradually find the one with high accuracy and low cost. While the method works, it's not the most efficient. "It can work pretty well for GPUs or smartphones," says Lin. "But it's been difficult to directly apply these techniques to tiny microcontrollers, because they are too small."

So Lin developed TinyNAS, a neural architecture search method that creates custom-sized networks. "We have a lot of microcontrollers that come with different power capacities and different memory sizes," says Lin. "So we developed the algorithm [TinyNAS] to optimize the search space for different microcontrollers." The customized nature of TinyNAS means it can generate compact neural networks with the best possible performance for a given microcontroller — with no unnecessary parameters. "Then we deliver the final, efficient model to the microcontroller," say Lin.

To run that tiny neural network, a microcontroller also needs a lean inference engine. A typical inference engine carries some dead weight — instructions for tasks it may rarely run. The extra code poses no problem for a laptop or smartphone, but it could easily overwhelm a microcontroller. "It doesn't have off-chip memory, and it doesn't have a disk," says Han. "Everything put together is just one megabyte of flash, so we have to really carefully manage such a small resource." Cue TinyEngine.

The researchers developed their inference engine in conjunction with TinyNAS. TinyEngine generates the essential code necessary to run TinyNAS' customized neural network. Any deadweight code is discarded, which cuts down on compile-time. "We keep only what we need," says Han. "And since we designed the neural network, we know exactly what we need. That's the advantage of system-algorithm codesign." In the group's tests of TinyEngine, the size of the compiled binary code was between 1.9 and five times smaller than comparable microcontroller inference engines from Google and ARM. TinyEngine also contains innovations that reduce runtime, including in-place depth-wise convolution, which cuts peak memory usage nearly in half. After codesigning TinyNAS and TinyEngine, Han's team put MCUNet to the test.

MCUNet's first challenge was image classification. The researchers used the ImageNet database to train the system with labeled images, then to test its ability to classify novel ones. On a commercial microcontroller they tested, MCUNet successfully classified 70.7 percent of the novel images — the previous state-of-the-art neural network and inference engine combo was just 54 percent accurate. "Even a 1 percent improvement is considered significant," says Lin. "So this is a giant leap for microcontroller settings."

The team found similar results in ImageNet tests of three other microcontrollers. And on both speed and accuracy, MCUNet beat the competition for audio and visual "wake-word" tasks, where a user initiates an interaction with a computer using vocal cues (think: "Hey, Siri") or simply by entering a room. The experiments highlight MCUNet's adaptability to numerous applications.

"Huge potential"

The promising test results give Han hope that it will become the new industry standard for microcontrollers. "It has huge potential," he says.

The advance "extends the frontier of deep neural network design even farther into the computational domain of small energy-efficient microcontrollers," says Kurt Keutzer, a computer scientist at the University of California at Berkeley, who was not involved in the work. He adds that MCUNet could "bring intelligent computer-vision capabilities to even the simplest kitchen appliances, or enable more intelligent motion sensors."

MCUNet could also make IoT devices more secure. "A key advantage is preserving privacy," says Han. "You don't need to transmit the data to the cloud."

Analyzing data locally reduces the risk of personal information being stolen — including personal health data. Han envisions smart watches with MCUNet that don't just sense users' heartbeat, blood pressure, and oxygen levels, but also analyze and help them understand that information. MCUNet could also bring deep learning to IoT devices in vehicles and rural areas with limited internet access.

Article Collected by
Md. Abdul Aziz
Assistant Professor, ECE

Placements & Higher Studies

One of our ECE department final year student Mr. Mannem Pavan kireeti bearing Roll number 178T1A0468 has selected in Raam Group in the campus placement which is held on 19-12-2020 with a Package of 14.4 LPA

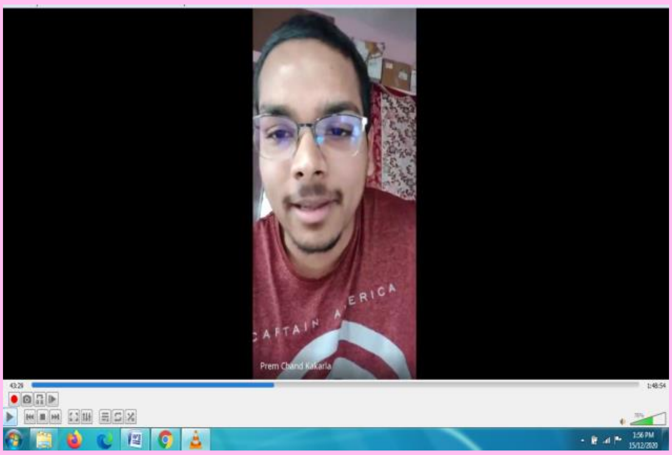
Alumni Meet

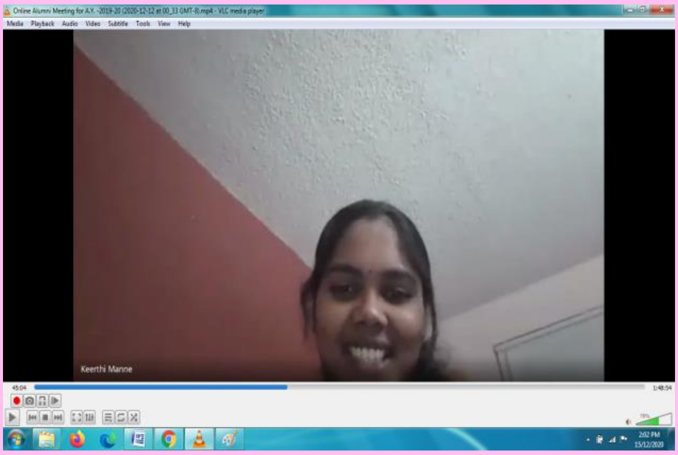
Our college has conducted online alumni meet on 12-12-2020, on this event some of our ECE department alumni students interacted with principal to share their views and also given suggestions on academics to improve the quality education to survive into real world

Sl. No	Suggestions	Action Plan
1	Need to include more number of electives in curriculum and also introduce electives related to computer science	Even if few members opt the elective then respective course will be offered by the department To upgrade the skills of students to the software industry will train the students by conducting certification courses like python, java, C and C++ etc.
2	Students need to do more number of projects and they must exhibit the models in competitions.	Department motivates the students to develop industry 4.0 related application models through mini projects and encourage them to participate in national level competitions
3	Need to conduct 25 to 30 days Campus Recruitment training programs for getting placements.	CRT classes included in the regular time table for this academic year and will continue in upcoming academic year also
4	Students should know about the interview process of a particular company priorly and focus on core jobs also.	We will plan to organize company specific training for outgoing batch students

Sl.No	Name of the Student	Roll Number	Batch

1	**Mr. KAKARLA PREM CHAND**	**148T1A0461**	**2014 – 2018**
2	**Mr. KUSAM RAM PRAKASH REDDY**	**148T1A0465**	**2014 – 2018**
3	**Ms. MANNE KEERTHI**	**138T1A0431**	**2013 – 2017**
4	**Mr. BOLEM J V S R SRI HARSHA**	**138T1A0424**	**2013 – 2017**
5	**Ms. MUPPIDI DEEPIKAKRISHNA**	**138T1A0413**	**2013 – 2017**





Academic Excellence Awards

Our college has conducted Annual Academic Excellence Awards function on 08-02-2021, on this occasion our ECE department student V.Pravallika Devi of 2020 passed out got 1st prize (Gold Medal) in academics. Chief Guest Dinesh Kumar Batra, Director, BEL, Bangalore has awarded the Gold Medal to her.

ఈనాడు విజయవాడ

09.02.2021 P.G N0:09

గొప్ప వ్యక్తులను ఆదర్శంగా తీసుకోండి

గంగూరు(పెనమలూరు), న్యూస్‌టుడే: స్వయం కృషితో ఉన్నత స్థానాలకు చేరుకున్న గొప్ప వ్యక్తులను విద్యార్థులు ఆదర్శంగా తీసుకోవాలని బెల్ సంస్థ డైరెక్టర్ దినేష్‌కుమార్(బెంగళూరు) బాత్రా పేర్కొన్నారు. సోమవారం గంగూరు ధనేకుల ఇంజినీరింగ్ కళాశాలలో అకడమిక్ ఎక్స్‌లెన్స్ అవార్డ్స్-2020 కార్యక్రమం ఘనంగా నిర్వహించారు. ముఖ్యఅతిథిగా హాజరైన దినేష్ కుమార్ బాత్రా గతేడాది ఇంజినీరింగ్ విద్యలో ఉత్తమ ప్రతిభ చాటిన కళాశాల విద్యార్థులకు బంగారు, వెండి, రజిత పతకాలు, ప్రోత్సాహక నగదు బహుమతులను అందజేసి అభినందించారు. కళాశాల డైరెక్టర్ డీకేఆర్‌కే రవిప్రసాద్, కార్యదర్శి ధనేకుల భవానీ ప్రసాద్, ప్రిన్సిపల్ కడియాల రవి, అధ్యాపకులు, విద్యార్థులు పాల్గొన్నారు.

విద్యార్థినికి పతకాన్ని అందజేస్తున్న భెల్ డైరెక్టర్ దినేష్‌కుమార్ బాత్రా

సాక్షి కృష్ణాజిల్లా

09.02.2021 P.G N0:09

విద్యార్థులు ఉత్తమ ప్రతిభ కనబర్చాలి

ప్రతిభ చూపిన విద్యార్థినికి బంగారు పతకం అందజేస్తున్న బీఈఎల్ డైరెక్టర్ దినేష్‌బాత్రా

పెనమలూరు: విద్యార్థులు ఉత్తమ ప్రతిభ కనబరిచి ఉన్నత శిఖరాలను అధిరోహించాలని బీఈఏ డైరెక్టర్ దినేష్‌బాత్రా అన్నారు. గంగూరు ధనేకుల ఇనిస్టిట్యూట్ ఆఫ్ ఇంజినీరింగ్ అండ్ టెక్నాలజీలో సోమవారం జరిగిన అకడమిక్ ఎక్స్‌లెన్స్ అవార్డులు-2020లో పాల్గొని ప్రసంగించారు. విద్యార్థులు అబ్దుల్‌కలాం, బిల్‌గేట్స్, ఎడిషన్ వంటి వ్యక్తులను ఆదర్శంగా తీసుకుని సాంకేతికపరంగా నూతన ఆవిష్కరణలు చేయాలని సూచించారు. ప్రతి విద్యార్థికి వ్యక్తిగత క్రమశిక్షణ చాలా అవసరమన్నారు. కాలేజీ డైరెక్టర్ రవిప్రసాద్ మాట్లాడుతూ తమ కాలేజీలో చదువుతున్న విద్యార్థుల భవిష్యత్తును దృష్టిలో ఉంచుకునే అత్యున్నత విద్యాబోధన చేస్తున్నామని వివరించారు. ఈ సందర్భంగా ఉత్తమ ప్రతిభ కనబర్చిన విద్యార్థులకు బంగారు, వెండి పతకాలతోపాటు పాలిటెక్నిక్ విద్యార్థులకు ఉపకార వేతనాలు అందజేశారు. ఈ కార్యక్రమంలో డైరెక్టర్ ధనేకుల భవానీప్రసాద్, ప్రిన్సిపాల్ డాక్టర్ కడియాల రవి పలువురు పాల్గొన్నారు.

Faculty Achievements

Patents

Our ECE department faculty "Dr. M Venkateswara Rao" received patent on 11-12-2020 for the invention of "Enhancement of Quality of Service in Wireless Sensor Network by Redundant Sensors Controlling" from Government of India.

INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

सत्यमेव जयते
GOVERNMENT OF INDIA

Controller General of Patents,Designs and Trademarks
Department of Industrial Policy and Promotion
Ministry of Commerce and Industry

Application Details	
APPLICATION NUMBER	202041051968
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	28/11/2020
APPLICANT NAME	1 . Dr.Shaik Bajidvali 2 . Dr.K.Riyazuddin 3 . Dr. Manikonda Venkateswara Rao 4 . Dr.A.SathishKumar 5 . Mr.Battina Srinuvasukumar 6 . Ms.S.Jayachitra 7 . Dr.Thanikaiselvan V 8 . Dr.K.G.S.Venkatesan 9 . Mr.Alok Misra 10 . Dr. Raj Gaurang Tiwari
TITLE OF INVENTION	ENHANCEMENT OF QUALITY OF SERVICE IN WIRELESS SENSOR NETWORK BY REDUNDANT SENSORS CONTROLLING
FIELD OF INVENTION	COMMUNICATION
E-MAIL (As Per Record)	bajid.vali@gmail.com
ADDITIONAL-EMAIL (As Per Record)	shaik.riyazuddin7@gmail.com
E-MAIL (UPDATED Online)	
PRIORITY DATE	
REQUEST FOR EXAMINATION DATE	--
PUBLICATION DATE (U/S 11A)	11/12/2020

FPDs & Workshops & STTPs

Sl.No	Name of the Faculty	Title of FDP/Workshop/STTP	Duration	Organized by
1	Dr. M Vamshi Krishna	AI Master Class using MATLAB(FDP)	18 Jan-1 Feb, 2021	Pantech Prolabs India Pvt. Ltd.
2	Dr. M Vamshi Krishna	5G Technology (40 hrs-FDP)	21 Dec-12 Jan, 2021	APSSDC-QuadGen Wireless Solutions
3	Dr. M Vamshi Krishna	Robotics (FDP)	4-8 Jan, 2021	AICTE Training and Learning (ATAL)-DIET
4	P Ramakrishna	Mixed Signal Design Approach for Artificial Intelligence Processors (STTP)	28 Dec-3 Jan, 2021	Lakkireddy Balireddy College of Engineering (A), Mylavaram
5	Krishna Saladi	Innovative Teaching Learning Methods for Inspiring Students (STTP)	18-23 Dec, 2020	Sagi Ramakrishna Raju Engineering college (A) Bhimavaram
6	Dr. M Vamshi Krishna	Global Navigation Satellite Systems (GNSS) (FDP)	18-22 Dec, 2020	AICTE Training and Learning (ATAL)-NIT, Mizoram
7	Dr. M Vamshi Krishna	Capacity Building (FDP)	14-18 Dec, 2020	AICTE Training and Learning (ATAL)-NIT, Patna

8	Dr. M Vamshi Krishna	Research Methodology (FDP)	7-11 Dec, 2020	AICTE Training and Learning (ATAL)-IIIT, Dharwad
9	Dr. M Vamshi Krishna	Wearable Devices (FDP)	30 Nov-04 Dec, 2020	AICTE Training and Learning (ATAL)-KITS
10	Krishna Saladi	Building an online signals and systems (Workshop)	27-30 Nov, 2020	TEQIP-III KITE, PPCCLT (IIT Bombay)

Conference

Sl.No	Name of the Faculty	Title of Paper	Duration	Name of the Conference
1	Dr. P Pavithra Roy	Optimal Relay Node Selection using Multi objective based Crow Search Optimization Algorithm for Multiuser Cooperative Communication Network	28-29 December, 2020	International Conference on Computer Vision, High Performance Computing, Smart Devices and Networks (CHSN-2020)

Journals

Sl.No	Name of the Faculty	Title of Paper	DOI	Name of the Journal
1	Dr. M Venkateswara Rao	AMC backed circularly polarized dual band antenna for Wi-Fi and WLAN applications	10.2478/jee-2020–0041	Journal of ELECTRICAL ENGINEERING, VOL 71(2020) (SCI)

PhD Registered during AY:2020-21

Sl.No	Name of the Faculty	University
1	Y Naga Prasanthi	KL University, Vijayawada
2	P Krishna Reddy	KL University, Vijayawada
3	P Veera Swamy	KL University, Vijayawada
4	K Radha	VIT University, Amaravati
5	P Rama Krishna	S V University

Webinars Conducted

One of our ECE department faculty “Dr. M Venkateswara Rao” delivered a webinar on “Introduction to RF Simulation Technologies and its Applications” for IV B.Tech I semester students on 19-12-2020 through online.

NSS EVENTS

DHANEKULA INSTITUTE OF ENGINEERING & TECHNOLOGY

NSS CELL

Date	**31-01-2021**
Event Name	**POLIO AWARENESS RALLY**
Venue	**Madduru Village**
In Association with	**JNTU, Kakinada**

As a part of NSS SPECIAL CAMP, DHANEKULA NSS UNIT has organized an awareness campaign on "PULSE POLIO" in Madduru Village. Around 50 Volunteers have participated in this awareness campaign. Volunteers have educated the people about the benefits of pulse polio drops. Volunteers have also tried to bring awareness among the villagers about polio disease and explained about the precautions that everyone must take to avoid that. On the same day, volunteers conducted rally with placards in four villages.

Faculty of ECE wishing the Chairman on eve of Newyear-2021

Faculty of ECE wishing the Chairman on eve of Newyear-2021

DHANEKULA INSTITUTE OF ENGINEERING & TECHNOLOGY

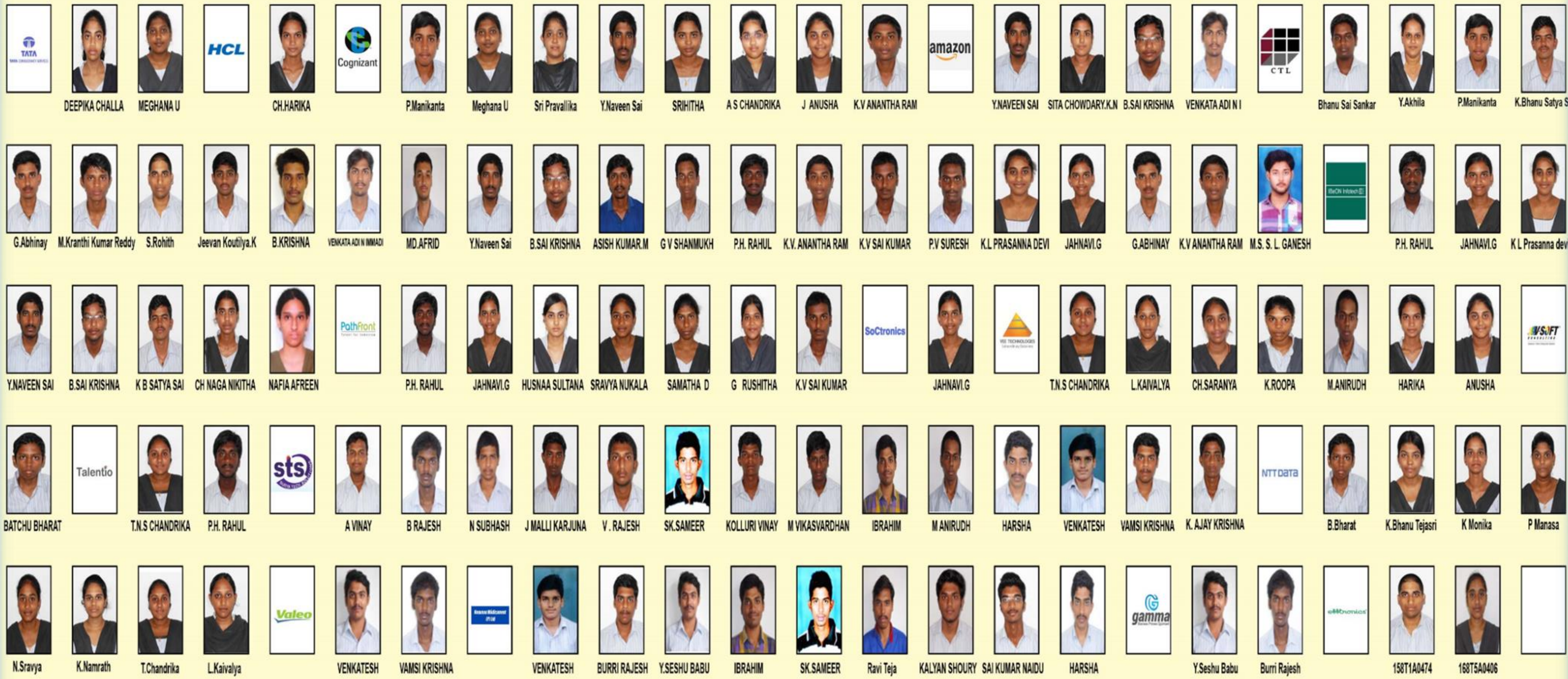
GANGURU, VIJAYAWADA – 521139

An ISO 9001-2015 Certified Institution & Accredited with NAAC & NBA

DEPARTMENT OF ECE

TRAINING, PLACEMENT & CAREER GUIDANCE CELL

WORDS REALLY FAIL TO EXPRESS OUR JOY AT THE NEWS OF YOUR SELECTION FOR THE REPUTED ORGANISATIONS RANGING FROM NATIONAL REPUTATION AND INTERNATIONAL RECOGNITION. YOUR SELECTION WAS HOWEVER, NO SURPRISE BECAUSE YOUNG AND TALENTED TECHNOCRATS OF YOUR CALIBER AND SUPERIOR INTELLIGENCE WERE BOUND TO FARE EXCELLENTLY.



DHANEKULA INSTITUTE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

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