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TECHNICAL
Newsletter

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- Earth's Inner Core Could Be Covered by 'Iron Snow': Study
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- Co2 could be captured directly from truck exhausts
- AMS launches inductive position sensor for high-speed motors

Designed by:- MCA Deptt.

Compiled by:-
Naman Kumar (MCA II year)
Shivam Nerwal (MCA I year)
Arya Mishra (MCA I year)

Coordinated by:-
Ms. Shalika Arora (Asst. Prof.,MCA)

Tech Trends of Decades

Chetan Vashistth

Year 2010 was the time when market was recovering from the recession of 2008 and people are betting high on SAAS based products. SAP was stable product and Salesforce was a new buzzword in market. Very few companies (mostly big players) were working with Mainframe computers and the high cost of training was something that made this skill precious.

Java5 was running stronger and fresh graduates were amazed with the increased number of classes in Java. This whole thing was a new world. Microsoft .Net was all time high and enterprise were buying it. I remember C# (combined with Visual Studio) was one of the most powerful weapons and when clubbed with Adobe Dreamweaver, it used to make developers undefeatable.

Golden days were those.

No, Java and .Net still not over but this is the time when developers write server in two line by using Golang or NodeJS.

Then came Smart Phones, especially Android and things changed forever. Android is one of the most popular products of Google and it's getting stronger even in 2020. AR and VR are new kids of Android and AR Core will be one big thing in this decade (trust my words). Android development and iOS development dominated market straight forward for 3-4 years. And if I remind my early startup days, that was the time when we got paid upto $40/hour for Android Development and we killed it

The internet push and affordable mobile devices generated enormous data and servers were cluttered with multimedia data. Two options were there, either flush all data and start fresh else use something to convert data to information. This was the time when the market invested in Big Data heavily and demand for Hadoop related ecosystem was all time high. Trend still continues.

Java was threatened with the Node server and NodeJS captured the market pretty fast. Just few years and all non-serious work is coded in Javacript only. Java is reserved for banking and enterprise and it is going to rule there. Frontend frameworks were there since long but it captured the speed and Angular was in high demand. This was Angular and React that gave birth to a new term, Fullstack Developer. And now, Fullstack is a norm. No company wants none less than fullstack now.

I would not comment on the global scenario but 2014 was the year when IoT was on steroids and it leaped day and night. IoT penetration is still very less and serverless edge computing and IoT platforms going to stay for next two decades at least. Yes, I have thrown two buzzwords in last line. These are Serverless edge computing and platform (Fiware is one biggie), please be updated in this section.

Python was long there but Data Science and ML was a booster to it and it took no time in jumping several places to reach at top place. Statistics, Algebra, Calculus and Mathematics are still hot and going to be hot forever but Python gave general powers to user. It's Python and some deep learning frameworks (Tensorflow, Pytorch) that given the superpowers in our hands and now anyone can train their machine learning model.

I want to appeal my readers to join Kaggle and do some mental gym there. It will build muscle and those muscle would help you forever.

It was 2017 and 2018, when DevOps came to a new buzzword. I would define it as platform/infra automation in layman terms. But believe me, it is not optional anymore. Every developer needs to know about CI/CD pipelines and automation testing frameworks. Otherwise you are going to face the tough time.

And, DevOps is really good to make one's life super easy and super managed. Life becomes too easy if you apply DevOps and Agile in your project. It's a practice rather than a new technology.

Then the wheel turned ahead and 2018 & 2019, both years was the years of Blockchain. Hyperledger Fabric should be taught in Engineering Graduation and students of hacker genes should play with Ethereum and should go deep by coding their own Blockchain. Blockchain is not new and even bitcoin was there in 2008, but this technology going to stay (stay as a compulsion) for decades. Someone going rewrite every OS with the soul of Blockchain again and data protection would be data protection in real terms again.

Above is a quick snapshot of last 10 years and even I am not satisfied with the short description above. But I would finish it here with the promise of detailed articles on the above-mentioned technologies in coming issues.
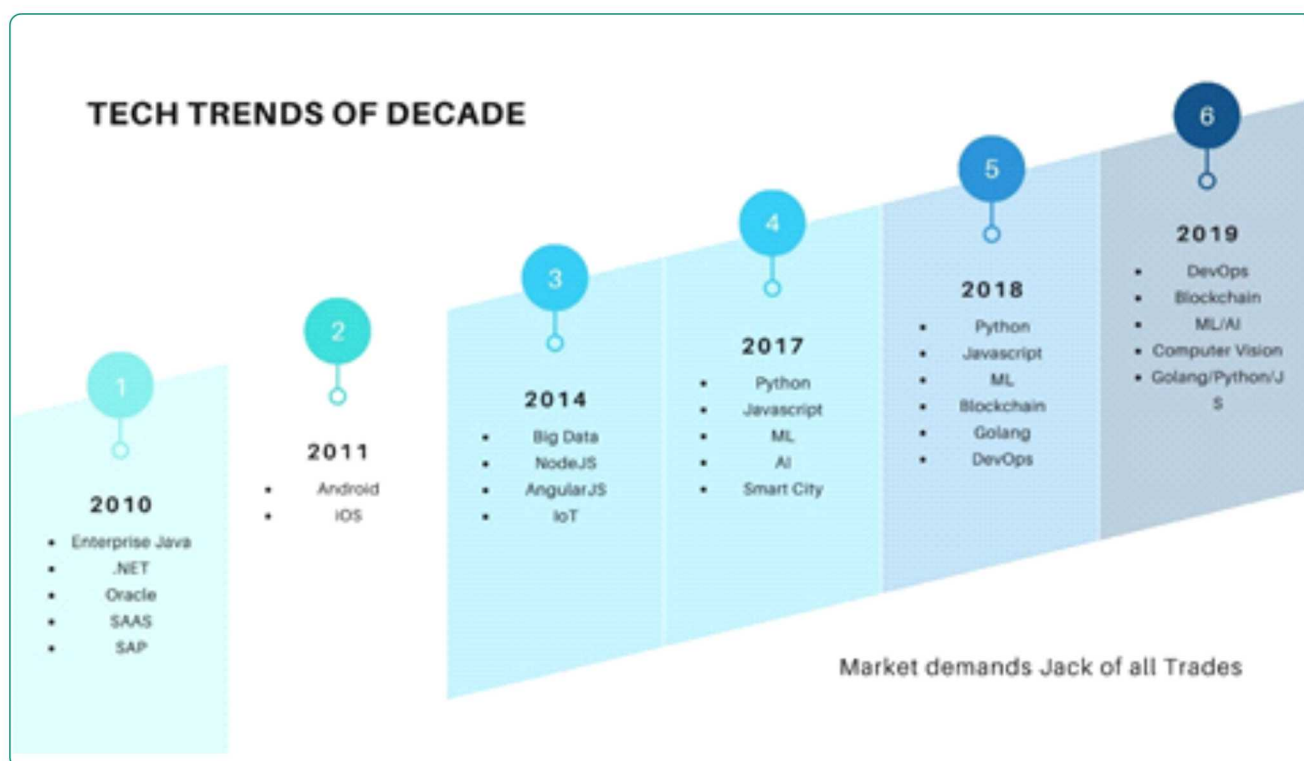
I want to stop here with this bonus paragraph for 2020.

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You can't ignore below in 2020
1. DevOps (CI/CD) pipeline
2. Cloud (AWS, Google Cloud, Azure)
3. Golang
4. Javascript (frontend and backend both)
5. Python (as a tool do anything and everything)
6. Distributed Computing

My personal pick for the new year is Cryptography, Graph Theory, Art of Computer Programming, and Clean Code.
Things don't end here, it's a start. Let's continue it in comments.

TECH TRENDS OF DECADE

2010
- Enterprise Java
- .NET
- Oracle
- SAAS
- SAP

2011
- Android
- iOS

2014
- Big Data
- NodeJS
- AngularJS
- IoT

2017
- Python
- Javascript
- ML
- AI
- Smart City

2018
- Python
- Javascript
- ML
- Blockchain
- Golang
- DevOps

2019
- DevOps
- Blockchain
- ML/AI
- Computer Vision
- Golang/Python/JS

Market demands Jack of all Trades

Chetan Vashistth
Batch:- 2007-2010
Technical Lead
NEC Technologies India Pvt. Ltd.

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Technical News
Vol.III Issue 1

Tech Startups May Soon Be Making Defence Gear

The army has invited ten startup innovators to describe high-tech products for military use. Startups described tech products at ARTECH 2019 in Delhi on Monday (December 23). Currently, 44 startups, which won the challenges under iDEX scheme, are provided with funding. The Indian army has invited ten startup innovators to describe high-technology products that military could use and resolve tech challenges.

First, it was the Finance Minister seeking inputs from Fin Tech startups before Union Budget 2020, now it is the Indian army adding another feather in the cap of startup ecosystem. The army has invited ten startup innovators to describe high-technology products that military could use.

At the fifth annual Army Technology Seminar (ARTECH 2019) in Delhi on Monday (December 23), the startups described products ranging from a humanoid robot that mimicked the actions of a human controller in a holographic suit, a thermal jacket made of fabric infused with graphene ink that generates heat on application of electric power to encrypted block-chain-based communications technology with multiple applications, such as Block Vote that lets soldiers on the border exercise their ballot in secret.

"136 of our over 150 problem statements issued over the last three years (in previous ARTECHs) have been responded to by academia and industry, army's deputy chief, Lieutenant General SS Hasabnis was quoted.

Army chief General Bipin Rawat released a "Compendium of Problem Definition Statements" which listed out specific technology challenges faced by the army. The army has asked startups to develop products which can resolve those challenges.

The Indian army is an early adopter of advanced technologies. For instance, after looking at ways to improve internet connectivity for soldiers posted in remote areas, recently, the Digital Communications Commission (DCC), a decision-making authority under the aegis of the department of telecommunications, approved the use of very small aperture terminal (VSAT) for soldiers in far-flung places.

VSAT is a two-way satellite ground station which is used in military and naval applications to improve communication in remote locations. VSAT, which transmits and receives data from satellites, is less than three meters tall and is capable of sending and receiving both narrow and broadband data to satellites in real-time. Multiple phones in a certain radius around the hub can be connected using these signals.

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Artificial Intelligence may predict long-term risks

Researchers have found that machine learning, patterns and inferences computers use to learn to perform tasks, can predict the long-term risk of heart attack and cardiac death. New York: Researchers have found that machine learning, patterns and inferences computers use to learn to perform tasks, can predict the long-term risk of heart attack and cardiac death.

According to the study, published in the journal Cardiovascular Research, machine learning appears to be better at predicting heart attacks and cardiac deaths than the standard clinical risk assessment used by cardiologists. "Our study showed that machine learning integration of clinical risk factors and imaging measures can accurately personalise the patient`s risk of suffering an adverse event such as heart attack or cardiac death," said the study researchers from the Biomedical Imaging Research Institute in US.For the findings, the research team studied subjects from the imaging arm of a prospective, randomised research trial, who underwent coronary artery calcium scoring with available cardiac CT scans and long-term follow-up. Participants here were asymptomatic, middle-aged subjects, with cardiovascular risk factors, but no known coronary artery disease.

Researchers used machine learning to assess the risk of myocardial infarction and cardiac death in the subjects, and then compared the predictions with the actual experiences of the subjects over fifteen years. Subjects here answered a questionnaire to identify cardiovascular risk factors and to describe their diets, exercise and marital status. The final study consisted of 1,912 subjects, fifteen years after they were first studied. 76 subjects presented an event of myocardial infarction and/or cardiac death during this follow-up time.

The subjects` predicted machine learning scores aligned accurately with the actual distribution of observed events.The atherosclerotic cardiovascular disease risk score, the standard clinical risk assessment used by cardiologists, overestimated the risk of events in the higher risk categories. Machine learning did not.

In unadjusted analysis, high predicted machine learning risk was significantly associated with a higher risk of a cardiac event. "While machine learning models are sometimes regarded as "black boxes", we have also tried to demystify machine learning; in this manuscript, we describe individual predictions for two patients as examples," said researchers "When applied after the scan, such individualized predictions can help guide recommendations for the patient, to decrease their risk of suffering an adverse cardiac event," they added.

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TESLA introduced the revolutionary Cyber truck

With a collective gasp and puzzled looks, the world was recently introduced to Tesla's newest vehicle. The so-called Cybertruck is an angular, stainless steel, all-electric pickup truck that quickly became polarizing.Some are loving its futuristic look and some are founding it puzzling. Regardless preorders for the Cybertruck approached 250,000 within a week. With the Cybertruck, Tesla has integrated several of its technologies into one offering. The truck features the same alloy being used at Musk's company, SpaceX. And it has lithium ion batteries, software and hardware for self-driving and a solar roof option.

Tesla has two main advantages that will likely make the Cybertruck a winner.

First, Tesla has an advanced and extensive charging network that allows the owners of its products to quickly refuel. There are currently more than 14,000 super chargers worldwide.

Second, Tesla has invested heavily in battery technology and manufacturing. It's gigafactories are expanding and using more renewable energy, including solar power, to reduce the ecological footprint of batteries. As a result, Tesla is able to scale up production and will probably be able to keep the cost of its vehicles lower than competitors.

Tesla's Cybertruck and the growing number of offerings by other manufacturers of EVs likely represent the beginning of a larger transition away from internal combustion engines.

Facebook's AI mathematician can solve university calculus problem

Machines are getting better at maths – artificial intelligence has learned to solve university-level calculus problems in seconds.
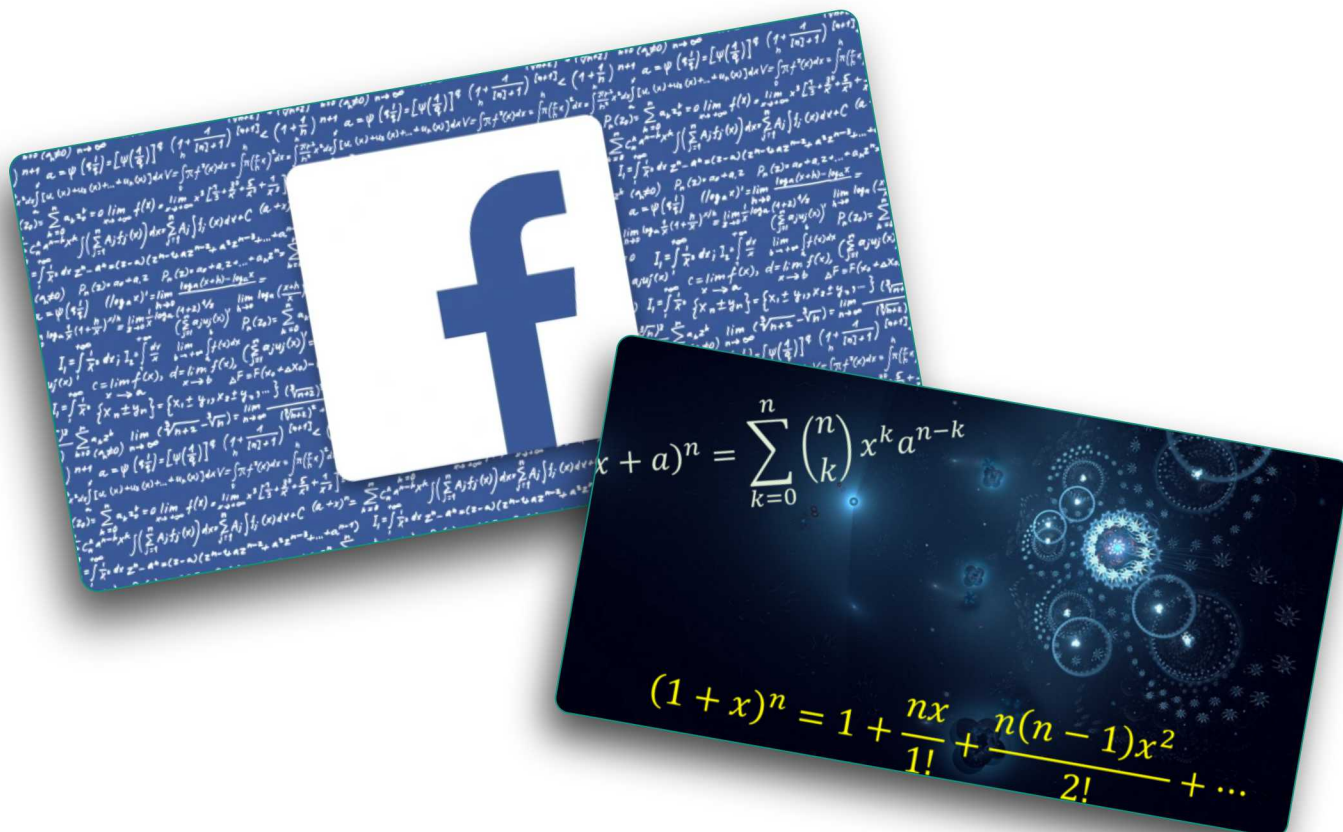
François Charton and Guillaume Lample at Facebook AI Research trained an AI on tens of millions of calculus problems randomly generated by a computer. The problems were mathematical expressions that involved integration, a common technique in calculus for finding the area under a curve.

To find solutions, the AI used natural language processing (NLP), a computational tool commonly used to analyse language. This works because the mathematics in each problem can be thought of as a sentence, with variables, normally denoted x, playing the role of nouns and operations, such as finding the square root, playing the role of verbs. The AI then "translates" the problem into a solution.

When the pair tested the AI on 500 calculus problems, it found a solution with an accuracy of 98 per cent. A comparable standard program for solving maths problems had only an accuracy of 85 per cent on the same problems.

The team also gave the AI differential equations to solve, which are other equations that require integration to solve as well as other techniques. For these equations, the AI wasn't quite as good, solving them correctly 81 per cent for one type of differential equation and 40 per cent on a harder type.Despite this, it could still correctly answer questions that confounded other maths programs.

Doing calculus on a computer isn't especially useful in practice, but with further training AI might one day be able to tackle maths problems that are too hard for humans to crack, says Charton. The efficiency of the AI could save humans time in other mathematical tasks, for example, when proving theorems, says Nikos Aletras at the University of Sheffield, UK.

$$x + a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$$

$$(1 + x)^n = 1 + \frac{nx}{1!} + \frac{n(n-1)x^2}{2!} + \cdots$$

A Year of Many New Beginnings for Indian Space

The year 2019 was a year of several new beginnings for India's space sector that is now on Mission 2.0 mode.

The year also saw the Indian Space Research Organisation (ISRO) scoring a couple of half centuries, like putting into orbit 50 foreign satellites and also sending up its 50th Polar Satellite Launch Vehicle (PSLV).

However, the one jarring note in the success symphony was the crash landing of India's moonlander Vikram on the lunar surface.

The year also saw ISRO and Department of Space (DoS) taking firm steps towards setting up of second rocket launch pad in Tamil Nadu; flying Indian rockets with indigenously developed navigation processor chip; formation of NewSpace India Limited to involve private sector in making rockets and also taking over the commercial activities of Antrix Corporation.

The NewSpace India had issued an Expression of Interest for first manufacturing five Polar Satellite Launch Vehicle (PSLV) rockets from private sector.

The year 2019 witnessed the ISRO touching the mark of 319-foreign satellite launches; deciding to go for another moon landing mission called Chandrayaan-3; setting up Human Space Flight Centre; starting the young scientist programme; signing agreement with Indian Air Force (IAF) to select and train Indian astronauts for the country's manned mission.

The space agency also laid the foundation stone for a centre to monitor and protect high value space assets from space debris.

The ISRO began the year with the launch of defence imaging satellite "Microsat R" for the Defence Research and Development Organisation (DRDO).Later in March, the DRDO shot down Microsat R to demonstrate its anti-satellite missile prowess.

During 2019, ISRO also launched several earth observations satellites like the Emisat, an electronic intelligence satellite for DRDO, Cartosat-3, radar imaging satellites RISAT-2B, and RISAT-2BR1. As India's eyes in the skies, these satellites will serve the needs of strategic sectors. In the communication satellite space, the ISRO launched the country's 40th communication satellite GSAT-31 by an Ariane 5 rocket belonging to Arianespace. On the rocket side, while ISRO flew its 50th PSLV and also launched two new variants of the rocket- PSLV-DL (with two strap-on motors) and PSLV-QL (with four strap-on motors).

The space agency flew a PSLV rocket in three orbits during the same mission and also used the fourth stage as an orbital platform carrying three experimental payloads.

The space agency also gave finishing touches to its new rocket-Small Satellite Launch Vehicle (SSLV) with a capacity to carry 500 kg. The rocket is expected to be flown next year. In June, ISRO Chairman K. Sivan surprised the nation by announcing that the country would build its own 20-tonne space station in the next 5ive to seven years' time after the first manned mission.

Earth's Inner Core Could Be Covered by 'Iron Snow'

Earth's core can't be sampled, so scientists study it by recording and analysing signals from seismic waves.

The Earth's inner core could be covered by "snow" made of tiny particles of iron which are much heavier than any snowflake on Earth's surface, says a study.

These particles fall from the molten outer core and pile on top of the inner core, creating piles up to 200 miles thick that cover the inner core, according to the study published online in the journal JGR Solid Earth.

The Earth's core can't be sampled, so scientists study it by recording and analysing signals from seismic waves (a type of energy wave) as they pass through the Earth.

However, aberrations between recent seismic wave data and the values that would be expected based on the current model of the Earth's core have raised questions.
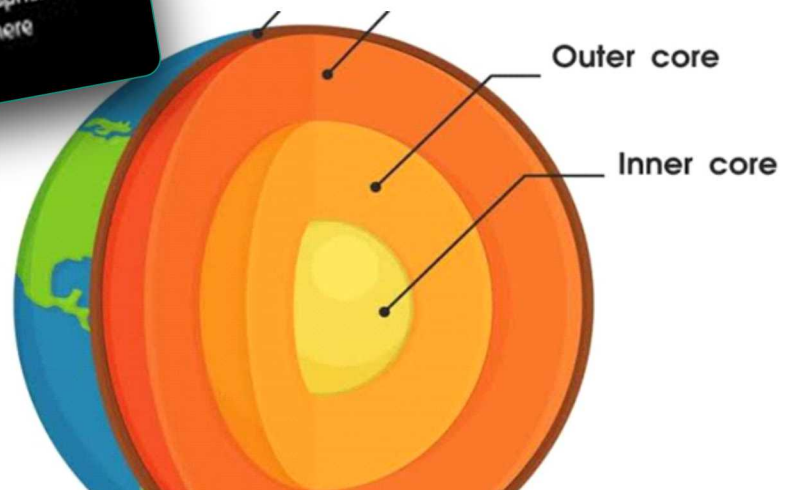
The waves move more slowly than expected as they passed through the base of the outer core, and they move faster than expected when moving through the eastern hemisphere of the top inner core.

The study proposes the iron snow-capped core as an explanation for these aberrations.

"It's sort of a bizarre thing to think about," said study co-author Nick Dygert, Assistant Professor at University of Tennessee who conducted the research during a postdoctoral fellowship at the University of Texas at Austin in the US.

"You have crystals within the outer core snowing down onto the inner core over a distance of several hundred kilometers," Dygert said.

The researchers point to the accumulated snow pack as the cause of the seismic aberrations. The slurry-like composition slows the seismic waves.

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Drones used to collect data from remote IoT devices

Scientists have developed a system to remotely collect data from IoT devices which would otherwise be unable to communicate with a central server.

The KAUST researchers believe such a system could be the key to connecting large numbers of smart objects spread across a broad geographical area.

"IoT networks will revolutionise the way we monitor, control and communicate with everything around us," researcher Osama Bushnaq said, adding, "To enable IoT networks, a huge number of low-cost, self-powered sensors are needed."

Traditional wireless data transfer is unsuitable for this purpose due to the limited power supply of each sensor and the complexity of connecting so many devices.
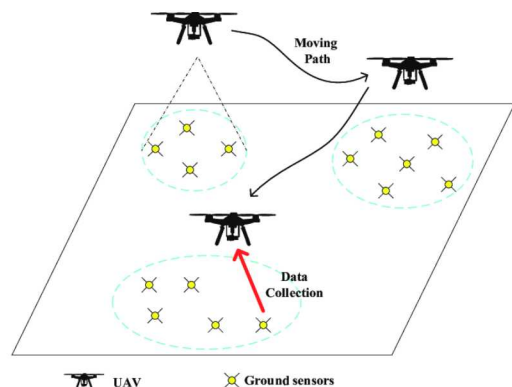
Sending UAVs to gather data via low-power, short-range transmission could be an alternative, transferring the burden of data aggregation from each individual sensor to a single machine that can autonomously return to base for recharging. the researchers made efforts to minimise the total mission time, optimise coverage area and lower the number of hovering locations. Imagine a field randomly covered with IoT sensors, said researcher Osama Bushnaq: "Covering a small area of the field at each hovering location improves communication between the UAV and the devices, reducing data aggregation time."

The team split the problem into components. For a given number of hovering locations they first calculated where the optimal ones would be. They then identified the best route between locations and optimised the data transmission rate.

"The process is repeated for different numbers of hovering locations until an optimal trade-off between hovering and traveling times is obtained," Bushnaq said. The approach cut the mission time by up to 10 times for a field of 100 square metres.

The team is currently testing the idea of using UAVs with IoT sensors for fire detection. "We are studying how such a system can be used for forest fire detection and the trade-off between system cost and fire-detection reliability," said Al Naffouri, who leads the lab developing the technology.

Other examples include crop fields that could be filled with sensors to monitor water and nutrient levels or networks of sensors that detect wildlife. earlier this year, a network of IoT sensors was installed at London Bridge station to gather data designed to help prevent delays and train cancellations.

Co2 could be captured directly from truck exhausts

Researchers based at Switzerland's École Polytechnique Fédéralede Lausanne (EPFL) have proposed a method for reducing the carbon emissions of trucks by 90 per cent with a small system which can be retrofitted to existing vehicles.

In Europe, transportation is responsible almost 30 per cent of total carbon emissions, of which most (72 per cent) comes from road transportation. As the world struggles to decarbonise in order to keep global average temperature rises to within 2°C, cutting down on emissions associated with transport has become a priority.

While a push towards electric and low-carbon personal vehicles will play a large part in decarbonising transport, reducing emission associated with public and commercial transport, such as trucks, remains a more stubborn challenge.

EPFL engineers suggest that trucks drivers could cut their emissions by a factor of 10 using a patented system which captures carbon straight from the exhaust, and liquifies it to be stored in a box on the roof. By cooling the vehicle's flue gases, it is possible to separate water from the gases, and then isolate the CO_2 from the nitrogen and oxygen in the fumes with a temperature swing absorption system, which uses frameworks designed at EPFL to absorb CO_2. Once the system is full of CO_2, it is heated (using heat from the vehicle's engines) to extract pure CO_2, which is then compressed into a liquid. This liquid can be stored in a tank and transported to a service station to be turned into conventional fuel, via a process powered by renewable energy.

"The truck simply deposits the liquid when filling up with fuel," said Professor François Maréchal, who led the project.

The entire process can be carried out within a capsule of 2x0.9x1.2m, which can be placed above the driver's carbon. According to Maréchal, the weight of the capsule and tank is just seven per cent of the vehicle's payload: "The process itself uses little energy, because all of its stages have been optimised."

A truck using 1kg of conventional fuel could produce 3kg of liquid CO_2, the researchers estimate. Just 10 per cent of the vehicle's total CO_2 emissions cannot be repurposed.

Although the researchers focused on a delivery truck in this study, this method could theoretically work with all sorts of other vehicles, including buses and boats, and with any type of fuel. Unlike electric and hydrogen-based systems, this system can be retrofitted to existing trucks to almost neutralise their contribute to climate change.

AMS launches inductive position sensor for high-speed motors

AMS has introduced an inductive position sensor for high-speed, automotive and industrial electric motors.

The new AS5715 sensor is ISO 26262 functional safety standard compliant. It is also highly configurable, and can be used in on-axis (end-of-shaft) and off-axis (through shaft or side-of-shaft) topologies, and with many types of multi-pole-pair motor.

Chris Feige, Executive Vice President for Automotive Solutions at ams, commented, "With the launch of the AS5715, ams takes another big step forward in its mission to provide technology for the greener, safer, smarter and more comfortable vehicle of tomorrow. Motors built with the AS5715 will be smaller and lighter, and deliver a smoother, more powerful output. This, coupled with cost savings are perfect reasons for automotive manufacturers to replace expensive, cumbersome resolvers with the AS5715 inductive sensor."

The company says the high accuracy, low-latency position measurements produced by the AS5715 can enable high-speed motors to maximise torque, limit torque ripple, and achieve high efficiency. A position sensor system based on an AS5715 IC and its associated coil printed on a simple, low-cost PCB can achieve accuracy up to ±0.3° at rotation speeds up to 100,000rpm in various motor types including four-pole-pair PMSMs.

The AS5715 provides two pairs of differential analog outputs, as sine waves and cosine waves. These may be resolved to an angle measurement by applying an arctan function in the host controller. Ams says that a fully redundant measurement system can be implemented by mounting two AS5715 ICs on the sensor board.

The new inductive sensor is available for sampling now, and an evaluation kit is available on request from AMS.