



KPR Institute of  
Engineering and  
Technology



# ***TECHBRICKS***

DEPARTMENT OF  
ARTIFICIAL INTELLIGENCE  
AND DATA SCIENCE

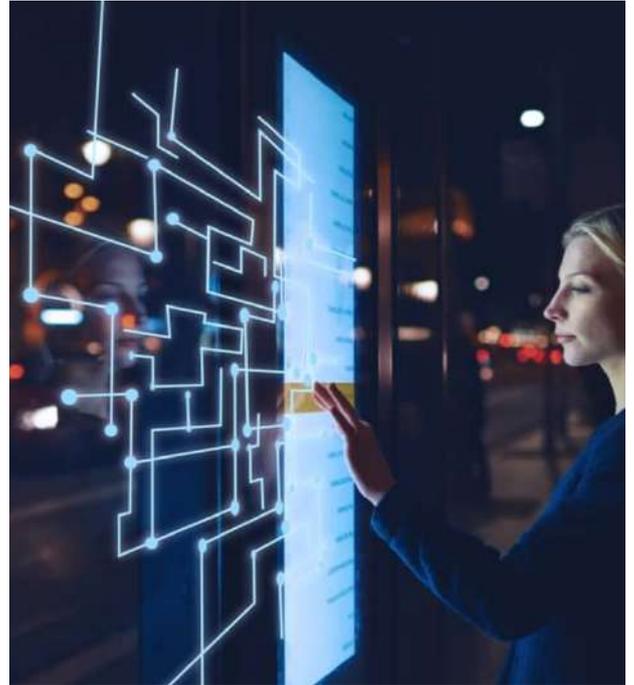
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AI IN MIT

# MIT LAUNCHES CROSS-DISCIPLINARY PROGRAM TO BOOST AI HARDWARE INNOVATION



**MIT HAS LAUNCHED A NEW ACADEMIA AND INDUSTRY PARTNERSHIP CALLED THE AI HARDWARE PROGRAM THAT AIMS TO BOOST RESEARCH AND DEVELOPMENT.**

**"A SHARP FOCUS ON AI HARDWARE MANUFACTURING, RESEARCH, AND DESIGN IS CRITICAL TO MEET THE DEMANDS OF THE WORLD'S EVOLVING DEVICES, ARCHITECTURES, AND SYSTEMS," SAYS ANANTHA CHANDRAKASAN, DEAN OF THE MIT SCHOOL OF ENGINEERING.**

"Knowledge-sharing between industry and academia is imperative to the future of high-performance computing."

There are five inaugural members of the program:

- Amazon
- Analog Devices
- ASML
- NTT Research
- TSMC

As the diversity of the inaugural members shows, the program is intended to be a cross-disciplinary effort.

"As AI systems become more sophisticated, new solutions are sorely needed to enable more advanced applications and deliver greater performance," commented Daniel Huttenlocher, dean of the MIT Schwarzman College of Computing and Henry Ellis Warren Professor of Electrical Engineering and Computer Science

"Our aim is to devise real-world technological solutions and lead the development of technologies for AI in hardware and software."



A key goal of the program is to help create more energy-efficient systems.

“We are all in awe at the seemingly superhuman capabilities of today’s AI systems. But this comes at a rapidly increasing and unsustainable energy cost,” explained Jesús del Alamo, the Donner Professor in MIT’s Department of Electrical Engineering and Computer Science.

“Continued progress in AI will require new and vastly more energy-efficient systems. This, in turn, will demand innovations across the entire abstraction stack, from materials and devices to systems and software. The program is in a unique position to contribute to this quest.”

Other key areas of exploration include:

- Analog neural networks
- New CMOS designs
- Heterogeneous integration for AI systems
- Monolithic-3D AI systems
- Analog nonvolatile memory devices
- Software-hardware co-design
- Intelligence at the edge
- Intelligent sensors
- Energy-efficient AI
- Intelligent Internet of Things (IIoT)
- Neuromorphic computing
- AI edge security
- Quantum AI
- Wireless technologies
- Hybrid-cloud computing
- High-performance computation

It’s an exhaustive list and an ambitious project. However, the AI Hardware Program is off to a great start with the inaugural members bringing significant talent and expertise in their respective fields to the table.

“We live in an era where paradigm-shifting discoveries in hardware, systems communications, and computing have become mandatory to find sustainable solutions—solutions that we are proud to give to the world and generations to come,” says Aude Oliva, Senior Research Scientist in the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL) and Director of Strategic Industry Engagement at the MIT Schwarzman College of Computing.

# Research of the Year

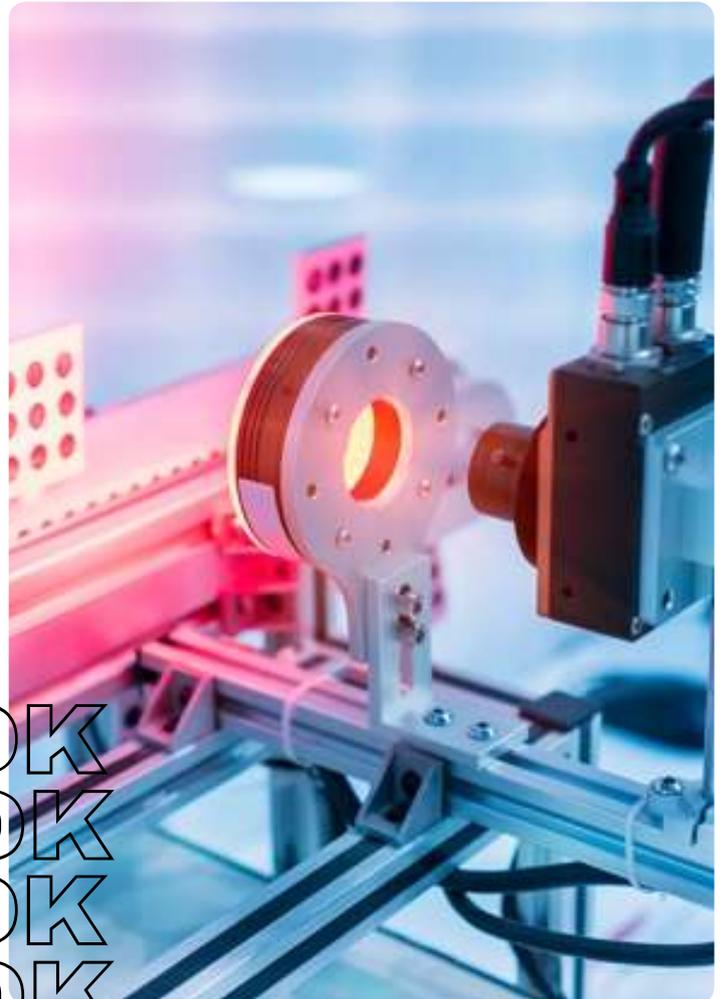
## GEORGIA STATE RESEARCHERS DESIGN ARTIFICIAL VISION DEVICE FOR MICROROBOTS

April 21, 2022 Categories: Applications,  
Research, Robotics,

Researchers at Georgia State University (GSU) have designed an 'electric eye' – an artificial vision device – for micro-sized robots.

Through using synthetic methods, the device mimics the biochemical processes that allow for vision in the natural world.

It improves on previous research in terms of colour recognition, a particularly challenging area due to the difficulty of downscaling colour sensing devices. Conventional colour sensors typically consume a large amount of physical space and offer less accurate colour detection.



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This was achieved through a unique vertical stacking architecture that offers a novel approach to how the device is designed. Its van der Waals semi-conductor powers the sensors with precise colour recognition capabilities whilst simplifying the lens system for downscaling.

"The new functionality achieved in our image sensor architecture all depends on the rapid progress of van der Waals semiconductors during recent years," said one of the researchers.

"Compared with conventional semiconductors, such as silicon, we can precisely control the van der Waals material band structure, thickness, and other critical parameters to sense the red, green, and blue colours."

ACS Nano, a scientific journal on nanotechnology, published the **research**. The article itself focused on illustrating the fundamental principles and feasibility behind artificial vision in the new micro-sized image sensor.

Sidong Lei, assistant professor of Physics at GSU and the research lead, said: "More than 80% of information is captured by vision in research, industry, medication, and our daily life. The ultimate purpose of our research is to develop a micro-scale camera for microrobots that can enter narrow spaces that are intangible by current means, and open up new horizons in medical diagnosis, environmental study, manufacturing, archaeology, and more."

The technology is currently patent pending with Georgia State's Office of Technology Transfer and Commercialisation.



AI-driven scientific research firm LabGenius is harnessing the power of Graphcore's IPU's (Intelligence Processing Units) to speed up its drug discovery efforts.

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## ***LabGenius uses Graphcore's IPU's to speed up drug discovery***



LabGenius is currently focused on discovering new treatments for cancer and inflammatory diseases. The firm combines AI, lab automation, and synthetic biology for its potentially life-saving work.

Until now, the company has been using traditional GPUs for its workloads. LabGenius reports that switching to Graphcore's IPU's in cloud instances from Cirrascale Cloud Services enabled its training of models to be reduced from one month to around two weeks.

"Previously we used GPUs and it took us about a month to have a functioning model of all the proteins that are out there," said Dr Katya Putintseva, a Machine Learning Advisor to LabGenius.

"With Graphcore, we reduced the turnaround time to about two weeks, so we can experiment much more rapidly and we can see the results quicker."

Specifically, LabGenius is using IPU's from Bristol, UK-based Graphcore to train a BERT Transformer model on a large data set of known proteins to predict masked amino acids. This, the company says, enables the model to effectively learn the basic biophysics of proteins.

"The system is looking across different features we could change about the molecule – from point mutations of simpler constructs to the overall composition and topology of multi-module proteins," explained Tom Ashworth, Head of Technology at LabGenius.

"It's making suggestions about what to design next... to learn about a change in the input and how that maps to a change in the output."

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One in two people now develop cancer in their lifetime. Current treatments often cause much suffering themselves and, while survival rates for most forms are increasing, only around 50 percent survive for ten years or more.

AI will help to find new cancer treatments that cause less suffering and greatly increase the odds of long-term survivability. However, while discovering new cancer treatments is the current focus of LabGenius, the company notes how the principles can be applied more widely to find new treatments for other horrible diseases that plague mankind.

"Graphcore has changed what we're able to do, accelerating our model training time from weeks to days," adds Ashworth. "For our data scientists, that's really transformative. They can move much more at the speed they think."

By using Graphcore IPUs provided in cloud instances from Cirrascale Cloud Services, LabGenius said training the model took about two weeks, down from the month it previously took using GPUs. As for which GPUs, LabGenius did not say, but our best guess is that they were Nvidia's, given the company's dominance in AI, plus the fact that AMD is only starting to become competitive in this area.

"Graphcore has changed what we're able to do, accelerating our model training time from weeks to days. For our data scientists, that's really transformative. They can move much more at the speed they think. For us, that's incredibly valuable," said Tom Ashworth, head of technology at LabGenius.

Graphcore was founded in 2012 by semiconductor veterans Nigel Toon and Simon Knowles, and the chip designer believes its IPUs are better suited for AI workloads than GPUs because the processors' architecture were built from the ground up with such applications in mind.

The chip designer said LabGenius plans to expand its use of the standard PyTorch implementations of BERT that are provided by Graphcore, which only require small code changes. The biotech firm is also looking to build new AI models using Graphcore systems, including Graph Neural Networks, for which the chip designer said its IPUs have "an innate architectural advantage."



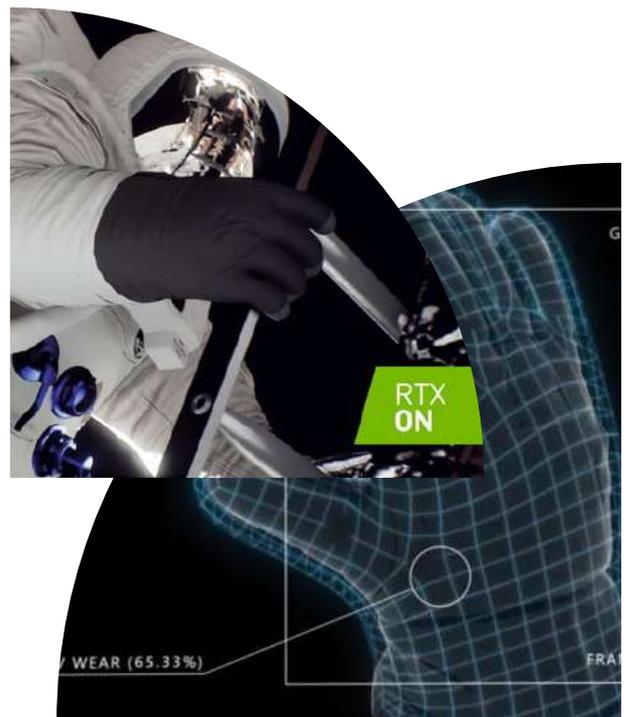
# AI system inspects astronauts' gloves for damage in real-time



Currently, astronauts will send back images of their gloves to Earth to be manually examined by NASA analysts. "This process gets the job done with the ISS's low orbit distance of about 250 miles from Earth, but things will be different when NASA once again sends people to the moon, and then to Mars – 140 million miles away from Earth," explains Tom Keane, Corporate Vice President of Mission Engineering at Microsoft, in a blog post.

Harnessing the power of HPE's Spaceborne Computer-2, the teams from the three companies are developing an AI system that can quickly detect even small signs of wear and tear on astronauts' gloves that could end up compromising their safety.

Microsoft and Hewlett Packard Enterprise (HPE) are working with NASA scientists to develop an AI system for inspecting astronauts' gloves. Space is an unforgiving environment and equipment failures can be catastrophic. Gloves are particularly prone to wear and tear as they're used for just about everything, including repairing equipment and installing new equipment.



To create the glove analyser, the project's team first started with images of new, undamaged gloves and those which featured wear and tear from spacewalk and terrestrial training. NASA engineers went through the images and tagged specific types of wear through Azure Cognitive Services' Custom Vision.

A cloud-based AI system was trained using the data and the results were comparable to NASA's own actual damage reports. The tool generates a probability score of damage to areas of each glove.

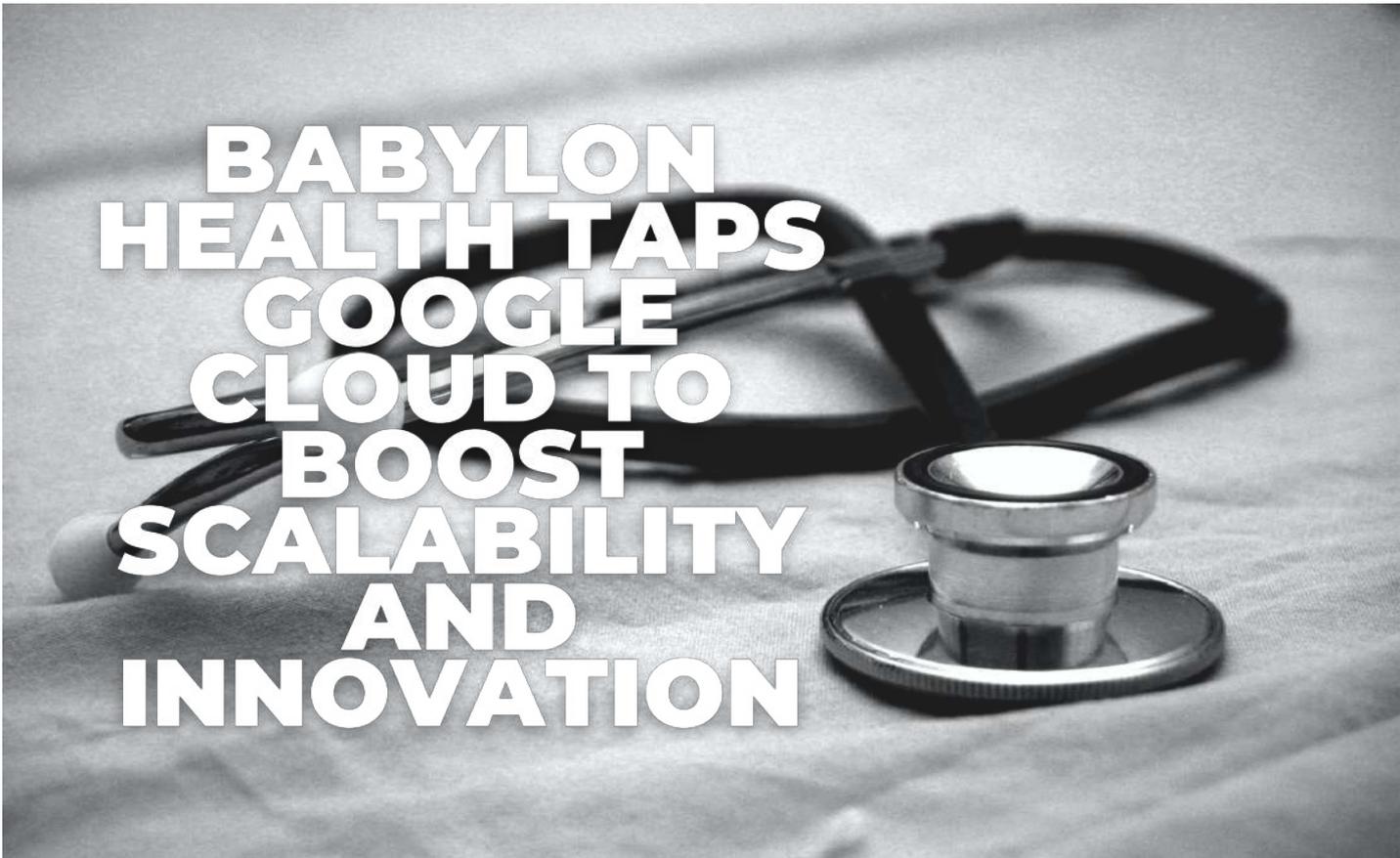
In space, images would be taken of astronauts' gloves while they remove their equipment in the airlock. These images would then be analysed locally using HPE's Spaceborne Computer-2 for signs of damage and, if any is detected, a message will be sent to Earth with areas highlighted for additional human review by NASA engineers.

"What we demonstrated is that we can perform AI and edge processing on the ISS and analyse gloves in real-time," said Ryan Campbell, senior software engineer at Microsoft Azure Space.

"Because we're literally next to the astronaut when we're processing, we can run our tests faster than the images can be sent to the ground."

GOING FORWARD, THE PROJECT COULD EXTEND TO DETECTING EARLY DAMAGE TO OTHER AREAS LIKE DOCKING HATCHES BEFORE THEY BECOME A SERIOUS PROBLEM. MICROSOFT EVEN ENVISIONS THAT A DEVICE LIKE HOLOLENS 2 OR A SUCCESSOR COULD BE USED TO ENABLE ASTRONAUTS TO VISUALLY SCAN FOR DAMAGE IN REAL-TIME.

"BRINGING CLOUD COMPUTING POWER TO THE ULTIMATE EDGE THROUGH PROJECTS LIKE THIS ALLOWS US TO THINK ABOUT AND PREPARE FOR WHAT WE CAN SAFELY DO NEXT - AS WE EXPECT LONGER-RANGE HUMAN SPACEFLIGHTS IN THE FUTURE AND AS WE COLLECTIVELY BEGIN PUSHING THAT EDGE FURTHER OUT," CONCLUDES JENNIFER OTT, DATA AND AI SPECIALIST AT MICROSOFT.



# BABYLON HEALTH TAPS GOOGLE CLOUD TO BOOST SCALABILITY AND INNOVATION

AI-powered healthcare service Babylon Health has announced a partnership with Google Cloud to boost scalability and innovation.

London-based Babylon Health is a digital-first health service provider that uses AI and machine learning technology to provide access to health information to people whenever and wherever they need it.

The company has partnered with private and public across the UK, North America, South-East Asia, and Rwanda with the aim of making healthcare more accessible and affordable to 24 million patients worldwide. “Our job is to help people to stay well and we’re on a mission to provide affordable, accessible health care to everyone in the world,” explains Richard Noble, Engineering Director of Data at Babylon.

Babylon Health’s rapid growth has led it to seek a partner to help it scale.

Babylon Health needs to store and process huge amounts of sensitive data.

By partnering with Google Cloud, the company claims that it’s been able to:

- Increase event data ingestion from 1 TB per week to 190 TB daily
- Reduce the wait time for users to access data from six months to a week
- Integrate over 100 data sources – providing access to 80 billion data points
- Save hundreds of hours of work by automatically transcribing 100,000 video consultations in 2021

“We work with a lot of private patient data and we must ensure that it stays private,” explains Natalie Godec, cloud engineer at Babylon. “At the same time, we must enable our teams to innovate with that data while meeting different national regulatory standards.”

Therefore, Babylon Health required a partner it felt could handle such demands. “We chose Google Cloud because we knew it could scale with us and support us with our data science and analysis and we could build the tools we needed with it quickly,” added Noble. “It offers the solutions that enable us to focus on our core business, access to health.”

Babylon Health says the move to Google Cloud has enabled it to better analyse its data using AI to unlock new tools and features that help clinicians and users alike. While building a new data model and giving access to users initially took six months, the company says it now takes under a week.

In London, Babylon Health offers its ‘GP at Hand’ service which – in partnership with the NHS – acts as a digital GP practice. Patients can connect to NHS clinicians remotely 24/7 and even be issued prescriptions if required. Where physical examinations are needed, patients will be directed to a suitable venue.

However, GP at Hand has been criticised as “cherry-picking” healthier patients—taking resources away from local GP practices that are often trying to care for sicker, more elderly patients.

## Growing pains

While initial problems are to be expected from any relatively new service; poor advice in a healthcare service could result in unnecessary suffering, long-term complications, or even death.

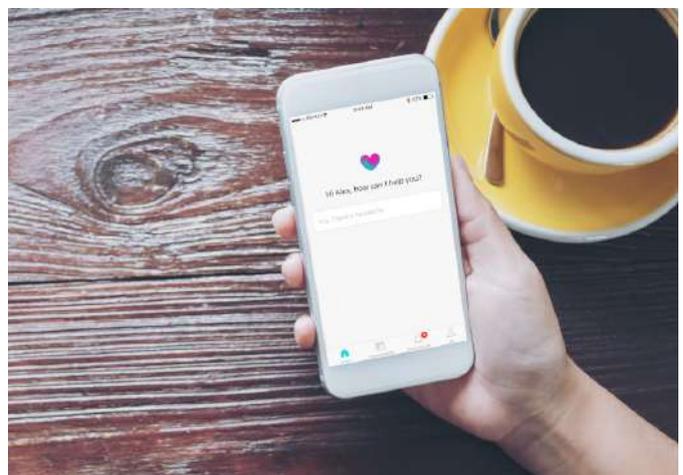
In 2018, Dr David Watkins – a consultant oncologist at Royal Marsden Hospital – reached out to AI News to alert us to Babylon Health’s chatbot giving unsafe advice.

Babylon Health called Dr Watkins a “troll” who has “targeted members of our staff, partners, clients, regulators and journalists and tweeted defamatory content about us”.

According to Babylon Health, Dr Watkins conducted 2,400 tests of the chatbot in a bid to discredit the service while raising “fewer than 100 test results which he considered concerning”.

Babylon Health claims that in just 20 cases did Dr Watkins find genuine errors while others were “misrepresentations” or “mistakes,” according to Babylon’s own “panel of senior clinicians” who remain unnamed.

Dr Watkins called Babylon’s claims “utterly nonsense” and questioned where the startup got its figures from as “there are certainly not 2,400 completed triage assessments”. He estimates conducting between 800 and 900 full triages and that some were repeat tests to see whether Babylon Health had fixed the issues he previously highlighted. That same year, Babylon Health published a paper claiming that its AI could diagnose common diseases as well as human physicians. The Royal College of General Practitioners, the British Medical Association, Fraser and Wong, and the Royal College of Physicians all issued statements disputing the paper’s claims.



# Ukraine harnesses Clearview AI to uncover assailants and identify the fallen

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Ukraine is using Clearview AI's facial recognition software to uncover Russian assailants and identify Ukrainians who've sadly lost their lives in the conflict.

The company's chief executive, Hoan Ton-That, told Reuters that Ukraine's defence ministry began using the software on Saturday.

Clearview AI's facial recognition system is controversial but indisputably powerful—using billions of images scraped from the web to identify just about anyone. Ton-That says that Clearview has more than two billion images from Russian social media service VKontakte alone.

Reuters says that Ton-That sent a letter to Ukrainian authorities offering Clearview AI's assistance. The letter said the software could help with identifying undercover Russian operatives, reuniting refugees with their families, and debunking misinformation.



Clearview AI's software is reportedly effective even where there is facial damage or decomposition.

Ukraine is now reportedly using the facial recognition software for free, but the same offer has not been extended to Russia. Russia has been widely condemned for its illegal invasion and increasingly brutal methods that are being investigated as likely war crimes. The Russian military has targeted not just the Ukrainian military but also civilians and even humanitarian corridors established to help people fleeing the conflict.

In response, many private companies have decided to halt or limit their operations in Russia and many are offering assistance to Ukraine in areas like cybersecurity and satellite internet access.

Clearview AI's assistance could generate some positive PR for a company that is used to criticism.

Aside from its dystopian and invasive use of mass data scraped from across the web, the company has some potential far-right links.

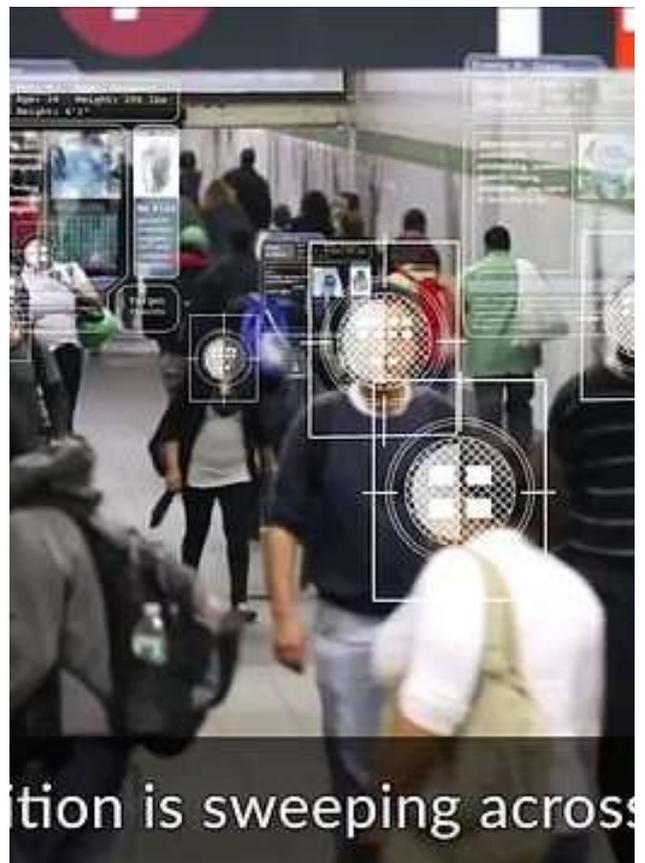
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“Common law has never recognised a right to privacy for your face,” Clearview AI lawyer Tor Ekeland once argued. Ekeland, it’s worth noting, gained notoriety as “The Troll’s Lawyer” after defending clients including self-described neo-Nazi troll Andrew Auernheimer.

Global regulators have increasingly clamped down on Clearview AI.

02.

In November 2021, the UK’s Information Commissioner’s Office (ICO) imposed a potential fine of just over £17 million to Clearview AI and ordered the company to destroy the personal data it holds on British citizens and cease further processing. Earlier that month, the OAIC reached the same conclusion as the ICO and ordered Clearview AI to destroy the biometric data it collected on Australians and cease further collection.



“I consider that the act of uploading an image to a social media site does not unambiguously indicate agreement to collection of that image by an unknown third party for commercial purposes,” said Australia’s Information Commissioner Angelene Falk at the time.

However, Clearview AI has boasted that police use of its facial recognition system increased 26 percent in the wake of the US Capitol raid. Clearview AI’s operations in Ukraine could prove to be a positive case study, but whether it’s enough to offset the privacy concerns remains to be seen.

# Intel boosts AI inferencing for developers with OpenVINO 2022.1

Intel has unveiled a major new version of OpenVINO to boost AI inferencing performance for developers.

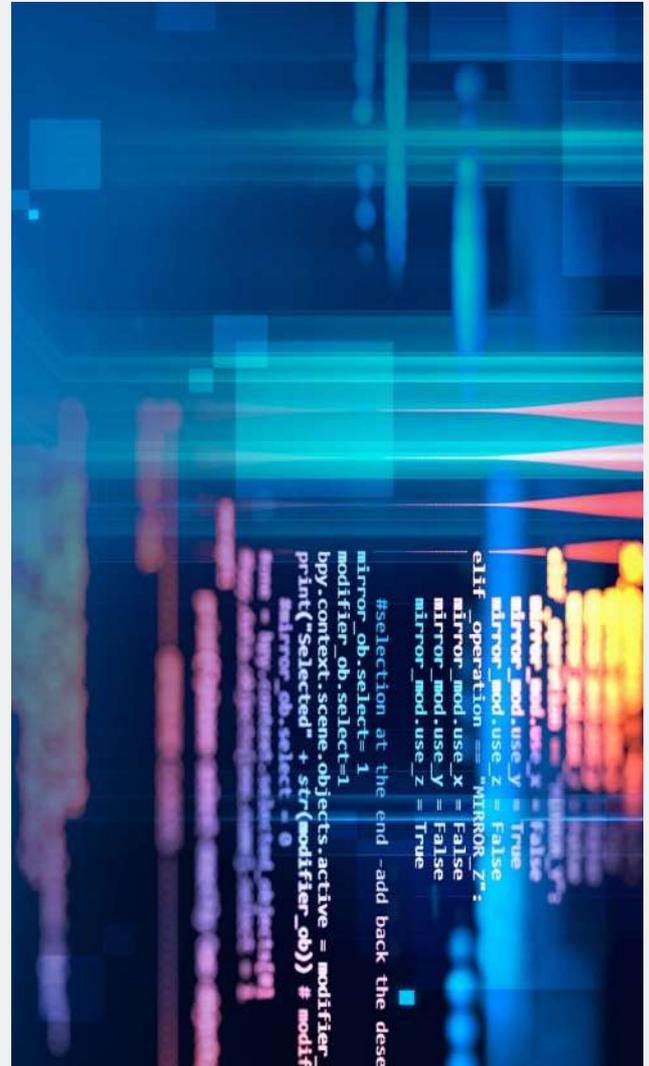
Hundreds of thousands of developers have used OpenVINO to deploy AI workloads at the edge. Features added to OpenVINO 2022.1 are based on three-and-a-half years of developer feedback, according to Intel.

Adam Burns, VP of OpenVINO Developer Tools in the Network and Edge Group at Intel, said:

**“The latest release of OpenVINO 2022.1 builds on more than three years of learnings from hundreds of thousands of developers to simplify and automate optimisations.**

**The latest upgrade adds hardware auto-discovery and automatic optimisation, so software developers can achieve optimal performance on every platform.**

**This software, plus Intel silicon, enables a significant AI ROI advantage and is deployed easily into the Intel-based solutions in your network.”**



Among the latest additions are “a greater selection of deep learning models, more device portability choices, and higher inferencing performance with fewer code changes.”

The expanded model support enables new types of deployments while a new automatic optimisation process can determine the compute and accelerators of a system and dynamically increase AI parallelisation and load balance based on compute and memory capacity.

OpenVINO is built on the foundation of oneAPI—an open standard for a unified application programming interface intended to be used across different compute accelerator architectures, including GPUs, AI accelerators, and field-programmable gate arrays.



OpenVINO is used by a number of high-profile Intel customers including Hitachi, BMW Group, ADLINK, American Tower, and more.

“With American Tower’s edge infrastructure, Intel’s OpenVINO deep learning capabilities and Zeblok’s AI platform-as-a-service, we can enable a complete smart solution for the market,” commented Eric Watko, VP of Innovation at American Tower.

OpenVINO 2022.1 was available from March 2022.

***OpenVINO toolkit (Open Visual Inference and Neural network Optimization) is a free toolkit facilitating the optimization of a deep learning model from a framework and deployment using an inference engine onto Intel hardware.***



**visualization  
of data in  
patrolling**

# Reducing crime with better visualisation of data

Effective policing relies on good data. The prevention and reduction of crime, particularly serious and organised crime, depends on law enforcement agencies being able to gain swift insights from the huge and increasing amount of information at their disposal.

The problem, given the sheer volume and variety of that data, is where to look first. So much of the data available to law enforcement data analysts and senior staff is unstructured. In other words, it doesn't line up in an orderly fashion in a relational database or spreadsheet. Police forces collect data of many different types – images from CCTV, phone records, social media conversations and images, and so on. Tying that variety of sources together to achieve valuable insights is difficult.

*What is artificial intelligence patrol?*

*Artificial intelligence (AI) patrol robots*

*By processing Big Data accumulated by the robots while guarding a unique facility, this mode allows predicting the places where the threat of an intruder will most likely arise.*

## **INTERPRETING VISUAL DATA:**

The human brain can process visual data 60,000 times faster than it does text. Data visualisation gives law enforcement professionals a crucial edge because smart visual tools amplify human abilities and allow them to more easily spot anomalies or patterns in the data. They can also better understand operations, identify areas for improvement, and uncover missing evidence links for faster case resolution.

## **DEPLOYING PREDICTIVE ANALYTICS:**

Having access to predictive and prescriptive analytics means that law enforcement professionals can build and deploy statistical models that provide alerts when new incidents are likely to happen, with context on circumstances that require pro-active investigation. Data visualisation is core to this because it provides an easy-to-understand translation of machine learning models and presents actionable intelligence. Patterns can be spotted, giving law enforcers a critical head start. Simple visual techniques such as assigning a range of amber to red colours to areas of concern on a map are highly effective.

## **SHARING CRITICAL DATA:**

Data visualisation is not just of academic use to data scientists. It is useful for everyone in the law enforcement team, from officers on the street to supervisors and analysts in the office. Detectives investigating organised crime can use the visual output of these tools to see the connections between people, property and financial transactions within a crime syndicate without needing data science qualifications. Anyone can see what the data is saying. Different teams, indeed different police forces, can share information seamlessly without fear of system incompatibilities.

More than that, today's tools can aggregate all the relevant information within and outside an agency and analyse it to deliver insights via a single platform. Crucially here, data can be handled in a secure manner so only those with the appropriate clearance can see it.

## **MANAGING TIGHT RESOURCES:**

Law enforcers are always looking for more efficient resource allocation and better ways to juggle limited amounts of personnel and equipment. Badly organised resources can impact everything from crime clearance, departmental morale, and perception in the community. With a data visualisation platform, they can spot areas that need immediate and long-term attention. They can also see which crimes have the biggest community impact and therefore need the most resources.

## **IMPROVING COMMUNITY RELATIONS:**

Data visualisation gives police a chance to connect with their communities, demonstrating the results of their work in a digestible and interactive form. They can showcase incident-rate trends, initiate awareness about emerging security concerns and foster community engagement. Sharing data builds trust and cooperation, making it easier in the longer term to gather evidence and solve cases.

The right platforms are available today to allow law enforcers to make faster and more accurate decisions. The insights derived from visual analytics are already helping keep law enforcement personnel and civilians safe, reduce operational costs and improve investigation outcomes.

The police are not in a position to share all of the successes they have enjoyed with data visualisation, but others can. For example, how the Scottish Environment Protection Agency (SEPA) uses data to address the threat of illegal polluters offers a close and relevant comparison.

SEPA has a vital role in working with government, industry and the public to ensure regulatory compliance with environmental rules. It has a range of enforcement powers which it can apply to ensure that regulations are complied with. However, enforcement relies on the ability to intelligently analyse data from multiple sources, on air, water and soil quality for example.





# Using deep learning to predict users' superficial judgments of human faces

**Many psychology studies have confirmed the biased nature of human judgments and decision-making. When interacting with a new person, for instance, humans often make a series of automatic and superficial judgments based solely on their appearance, facial features, ethnicity, body-type, and body language.**

**Researchers at Princeton University, Stevens Institute of Technology, and the Booth School of Business of the University of Chicago have recently tried to predict some of the automatic inferences that humans make about others based solely on their face, using deep neural networks. Their paper, published in PNAS, introduces a machine learning model that can predict the arbitrary judgments users will make about specific pictures of faces with remarkable accuracy.**

## PSYCHOLOGIST SAYS,

"As psychologists, we are interested in how people perceive and judge faces, especially when there are important consequences, such as hiring and sentencing decisions involved," Joshua Peterson, one of the researchers who carried out the study, told TechXplore "However, most work up to now was limited to studying artificial 3D face renderings or small sets of photographs."

**"As the base network we chose is generative, we are also able to manipulate faces along these interpretable dimensions, such that they will be judged as more or less e.g., trustworthy, which we verified in separate behavioral experiments," Peterson said.**

In recent years, computer scientists have developed a wide range of advanced machine learning models that can analyze and classify large amounts of data, predict specific events with good accuracy, and generate images, audio recordings or texts. While reviewing previous literature focusing on human face judgments, however, Peterson and his colleagues noticed that very few studies explored this topic using state-of-the-art machine learning tools.

"The main objective of our recent study was to produce a scientific model of people's impressions of faces that generalized to as many possible faces and attributes (e.g., trustworthiness) as possible," Peterson said. "We also wanted the model to double as a tool for generating and manipulating face stimuli in psychology, and also represent a new standard for studying arbitrary attribute inferences for faces.

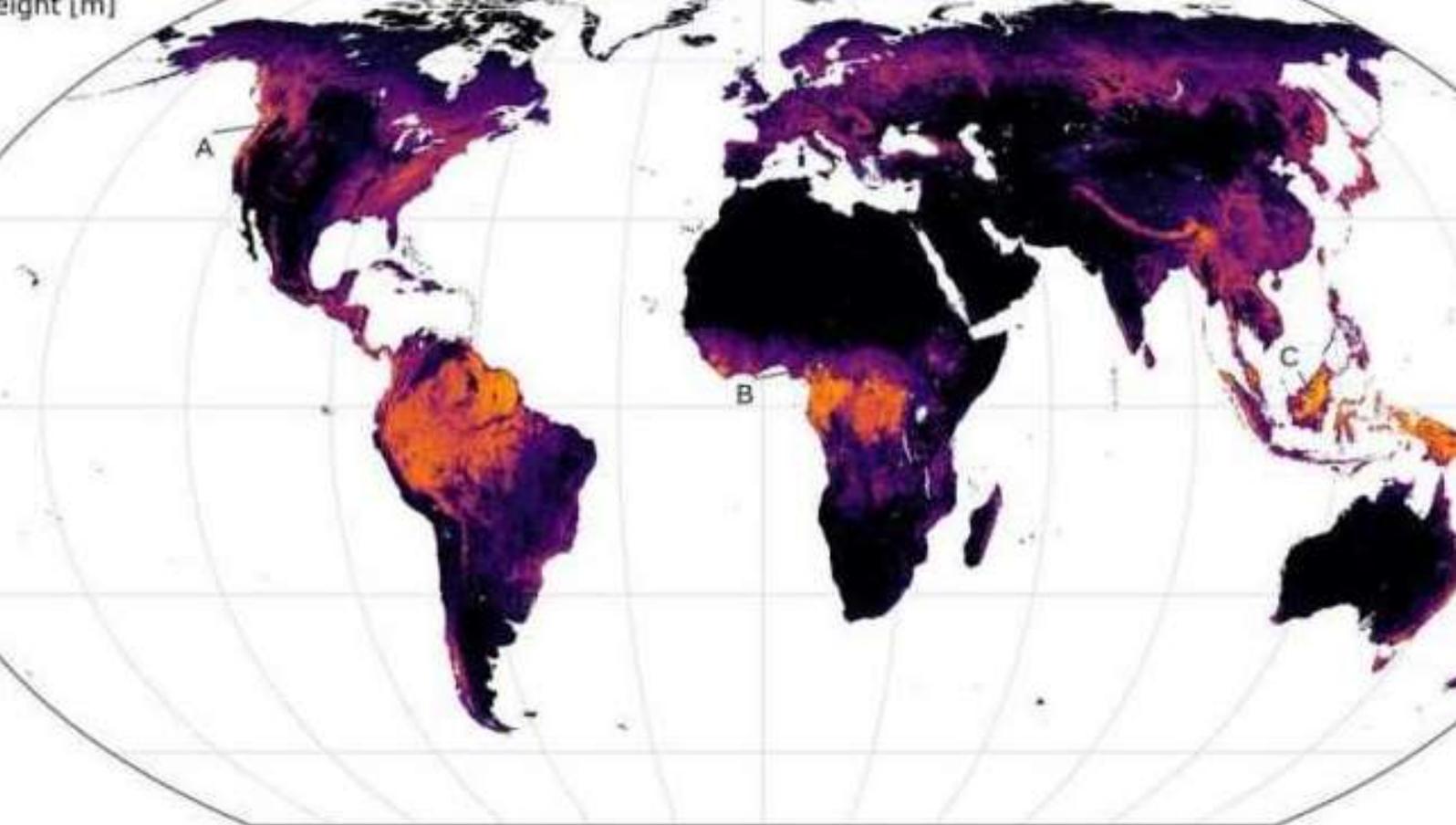
In the past, deep neural network-based models were primarily used to automatically detect facial expressions, basic emotions, or the presence of specific accessories (e.g., glasses, sunglasses, earrings, etc.). Peterson and his colleagues, on the other hand, wished to use deep neural networks to model personality-related attributes that humans might typically infer from faces, such as trustworthiness.

***"Even though our dataset is the largest of its kind in psychology, containing over 1 million judgments, it's still not big enough to train a neural network model from scratch," Peterson said. "Instead, we assume that existing models have already adequately learned the general structure of faces from a larger unlabeled dataset, and then we can aim our own behavioral data directly at the remaining problem of relating that structure to psychological inferences."***

***Instead of learning the weights of an entirely new neural network, which is what deep learning models for the analysis of faces are typically programmed to do, the model developed by Peterson and his colleagues specifically learns weights that associate judgments of trustworthiness to facial features that were already uncovered by another existing model. This ultimately allowed the researchers to interpret their deep neural network's opaque internal states from a psychological standpoint.***

***"The current dataset that powers our model consists of judgments from a mostly White, North American population," Peterson said. "One important extension of the work will be to ask how the biases we are studying differ across much more diverse populations. Anyone who wants to help us do this can participate in our study by judging faces at***

***[https://demo.onemillionimpressions.com/v2/consent/.](https://demo.onemillionimpressions.com/v2/consent/)***



## Neural network can read tree heights from satellite images

Using an artificial neural network, researchers at ETH Zurich have created the first high-resolution global vegetation height map for 2020 from satellite images. This map could provide key information for fighting climate change and species extinction, as well as for sustainable regional development planning.

### **1** TRANSPARENCY BY ESTIMATING UNCERTAINTIES

Lang didn't prepare just one CNN for this task, but several. This is known as an ensemble. "An important aspect for us was also letting users know the uncertainty of the estimate," he says. The neural networks—five altogether—were trained independently of each other, with each one returning its own estimate of tree height. "If all the models agree, then the answer is clear based on the training data. If the models arrive at different answers, it means there is a higher uncertainty in the estimate," Lang explains.

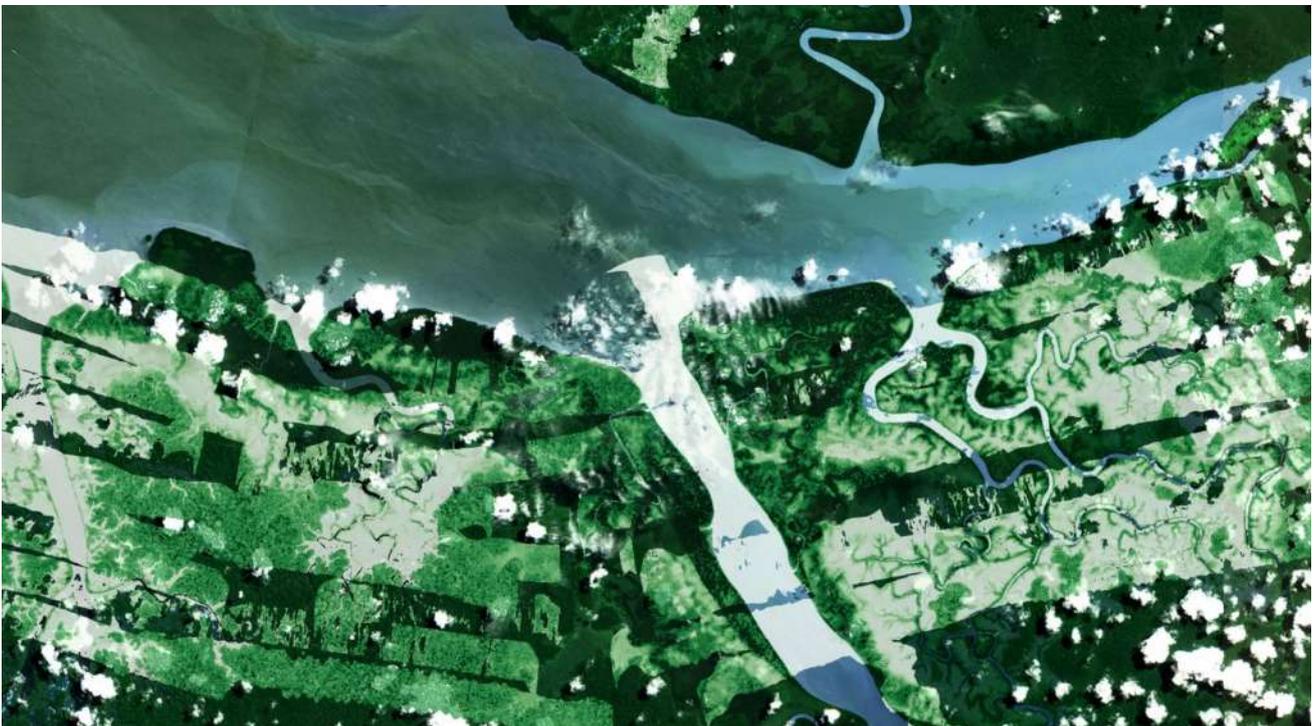
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In an interview, Ralph Dubayah, the Principal Investigator of NASA's Global Ecosystem Dynamics Investigation (GEDI) mission, explains: "We simply do not know how tall trees are globally. [...] We need good global maps of where trees are. Because whenever we cut down trees, we release carbon into the atmosphere, and we don't know how much carbon we are releasing."

# 3

Analyzing and preparing precisely this kind of environmental data is what the EcoVision Lab in the ETH Zurich Department of Civil, Environmental and Geomatic Engineering specializes in. Founded by ETH Zurich Professor Konrad Schindler and University of Zurich Professor Jan Dirk Wegner in 2017, this lab is where researchers are developing machine learning algorithms that enable automatic analysis of large-scale environmental data. One of those researchers is Nico Lang. In his doctoral thesis, he developed an approach—based on neural networks—for deriving vegetation height from optical satellite images. Using this approach, he was able to create the first vegetation height map that covers the entire Earth: the Global Canopy Height Map.

The map's high resolution is another first: thanks to Lang's work, users can zoom in to as little as 10x10 meters of any piece of woodland on Earth and check the tree height. A forest survey of this kind could lead the way forward particularly in dealing with carbon emissions, as tree height is a key indicator of biomass and the amount of carbon stored. "Around 95 percent of the biomass in forests is made up of wood, not leaves. Thus, biomass strongly correlates with height," explains Konrad Schindler, Professor of Photogrammetry and Remote Sensing.



# FOUNDATION FOR FUTURE ECOLOGICAL RESEARCH

Thanks to its high resolution, Lang's global map provides detailed insights: "We have already discovered interesting patterns," Schindler says. "In the Rocky Mountains, for example, forests are managed in fixed sections, and the rainforest also forms interesting structures that can't be coincidental." Now ecologists can interpret these captured patterns and data globally.

To allow this research to continue, the map and its source code will be made publicly accessible (see link). The first interested parties have already been in touch: Walter Jetz, a professor at Yale University, wants to use the Global Canopy Height Map for biodiversity modeling. However, the map could also be of interest to governments, administrative bodies and NGOs. "Thanks to Sentinel-2, vegetation height can be recalculated every five days, making it possible to monitor rainforest deforestation," Lang says.

In addition, he adds, it is now also possible to globally validate regional findings, such as the way tropical leaf canopies act as a climate buffer. Coupled with the High Carbon Stock Approach, which classifies forests according to their carbon storage and biodiversity value, the vegetation height map is an important foundation for maintaining and strengthening ecosystems. According to Lang's calculations, vegetation with a height of more than 30 meters is found on only 5 percent of the landmass, and only 34 percent of it is located in protected areas.

With the GEDI mission set to end in 2023, Lang's newly developed approach offers the possibility to continue mapping vegetation height in future. However, getting the GEDI mission extended—something that is currently also being discussed in the media internationally—is key to comparing its data with future satellite missions such as the ESA Biomass mission and calibrating the model for changes.



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