SCIENCE NEWS

Meet RobERt, the Dreaming Detective for Exoplanet Atmospheres

Machine-learning techniques that copy human understanding and imagining processes are being set up in the search for livable worlds beyond our solar system. The theory of understanding the semantic network, called RobERt (Robotic Exoplanet Recognition), has been developed by stargazers at UCL to analyse through detections of light emitted from far-away planetary systems and recapture spectral information about the gases present in the exoplanet atmospheres. RobERt was presented at the National Astronomy Meeting (NAM) 2016 in Nottingham by Dr. Ingo Waldmann on Tuesday 25th June.

"Distinctive kinds of molecules consume and transmit light at some particular wavelengths, thereby constituting a unique pattern of lines within the electromagnetic spectrum," interpreted Dr. Waldmann, who leads RobERt's advancement group. "We can take light that has been refined through an exoplanet's atmosphere or reflected from its cloud-tops, split it like a rainbow and then pick out the 'fingerprint' of features associated with the different molecules or gases. Human brains are really good at finding these patterns in spectra and label them from experience, but in real time it will be a tedious job for them to deal with such enormous size of data.

We assembled RobERt to individually or unrestrictedly pick up from given illustrations and to develop based on his own involvement as it encounters with different things. Truthfully, RobERt has adapted properties similar to stargazer or an astronomer, it has been noticed that RobERt has a quite nice sentiment for what molecules are inside a spectrum and which are the most promising data for more detailed analysis. But what usually takes days or weeks to humans RobERt takes mere seconds for analyzing giant sized detailed data."

Deep belief neural networks, or DBNs, were developed over more than a decade ago and are generally utilised for speech awareness, web or internet-based resources and tracking

client behaviour. RobERt's DBN has three layers of unit processors, or 'neurons'. Data is fed into a base layer of 500 neurons, which make an initial filter of the data and pass a subset behind to the second layer. Here, 200 neurons clarify the selection and pass data up to the third layer of 50 neurons to conclude clearly recognition of the gases most likely to be available on exoplanet's surface.

To train RobERt for his challenge, Waldmann and his teammates at UCL created a total of 85,750 simulated spectra, covering five different types of exoplanet ranging from GJ1214b, a potential "ocean planet," to WASP-12, a hot Jupiter revolving very close to its star. Each spectrum in the training set contained the unique fingerprint impression of an isolated gas species. RobERt's learning progress was proved at intervals during the training with 'control' spectra. At the finishing point of the preparation phase, RobERt had a recognition efficiency of 99.7 per cent.

"RobERt has learned to resolve factors such as commotion, restricted wavelength ranges, and mixtures of gases," said Waldmann. "He can figure out components such as water and methane in a meld atmosphere with a high tendency, even when the input originates from the finite limited wavebands that most space instruments can afford and when it contains overlapping features."

RobERt's DBN can also be reversed so that instead of analyzing data fed into the system, he can enter an 'imagining state' in which he can produce full spectra based on his own understanding.

"Robots truly do dream. We can inquire RobERt to dream up what he considers water spectrum will resemble, and he's proved exactly accurate," interpreted Waldmann.

"This envisioning capacity has been extremely advantageous when an attempt to identify features in inadequate data. RobERt can use his nightmare state to fill in the differences. The James Webb Space Telescope, due for discharge in 2018, will tell us further about the atmospheres of exoplanets, and new facilities like Twinkle or ARIEL will be coming on the internet over the next ten years that are particularly custom to characterising the atmospheres of exoplanets. The measure of data these missions will provide will be astonishing. RobERt will play a vital role in helping us to analyze data from these missions and find out what these distant worlds are really like."

***Source*: Sciencedaily/ Royal Astronomical Society (RAS)**

Mercury's Origins Traced to Rare Meteorite

https://www.sciencedaily.com/releases/2016/06/160627132939.htm

Source: **Sciencedaily/ Massachusetts Institute of Technology**

Over 4.6 billion years ago, our solar system was absolutely uncertain of disintegrated gas and revolved debris. Fine particles of gas and dirt bundled together to form bigger and giant sized meteoroids that in turn crumbled together lead to the formation of planets. According to geologists, soon after they get formed, these planets — and particularly Mercury — were blazing spheres of molten material, that took millions of years to cool.

Geologists at MIT have discovered a bit of Mercury's composition a few billion years ago, soon after the planet formed, was that of an extremely rare meteorite found on

earth. Also, it has been observed that its core temperatures decreased by nearly 240 degrees Celsius, or 464 degrees Fahrenheit.

Researchers probe on the basis of fast cooling rate and the composition of lava deposits on Mercury's surface, that the planet likely has the composition of an enstatite chondrite — a type of meteorite that is present extremely rare here on Earth.

According to Timothy Grove, the Cecil and Ida Green Professor of Geology in MIT's Department of Earth, Atmospheric, and Planetary Sciences, this new information is advantageous for knowing the early background of the earth as well as Mercury's past.

"Here we are today, with 4.5 billion years of planetary evolution, and because the Earth has such a dynamic interior, because of the water we've preserved on the planet, [volcanism] just wipes out its past," Grove says. "On planets like Mercury, early volcanism is much more dramatic, and [once] they cooled down there were no later volcanic processes to uncover the early history. This is the first place where we actually have an estimate of how fast the interior cooled during an early part of a planet's history."

Grove and his colleagues, including researchers from the University of Hanover, in Germany; the University of Liége, in Belgium; and the University of Bayreuth, in Germany, have published their results in Earth and Planetary Science Letters.

Compositions in Craters

For their analysis, the team employed data collected by NASA's MESSENGER spacecraft. The MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) probe orbited Mercury between 2011 and 2015, collecting measurements of the planet's chemical composition with each flyby. During its mission, MESSENGER produced images that revealed kilometre-thick lava deposits covering the entire planet's surface.

An X-ray spectrometer is present on the spacecraft which is used to measure the X-ray radiation from the planet's surface, produced by solar flares on the sun, to determine the chemical composition of nearly more than 5,800 lava deployed on Mercury's surface.

Grove's co-author, Olivier Namur of the University of Hanover, recalculated the surface compositions of nearly all 5,800 locations, and correspond each composition with the type of terrain in which it was found, from heavily cratered regions to those that were less impacted. The density of a region's craters can tell something about that region's age: The more craters there are, the older the surface is, and vice versa. The researchers were able to correlate Mercury's lava composition with age and found that older deposits, around 4.2 billion years old, contained elements that were very different from younger deposits that were estimated to be 3.7 billion years old.

"It's true of all planets that different age terrains have different chemical compositions because things are changing inside the planet," Grove says. "Why are they so different? That's what we're trying to figure out."

A Rare Rock, 10 Standard Deviations Away

To answer that question, Grove tried to recover a lava deposit's path, from the time

it melted inside the planet to the time it ultimately erupted onto Mercury's surface.

To get some result, he started by exhilarating Mercury's lava deposits in the lab. From MESSENGER's 5,800 compositional data points, Grove selected two extremes: one representing the older lava deposits and one from the younger deposits. He and his co-workers transformed the lava deposits' element ratios into the chemical ingredient that make up the rock, then followed this recipe to create synthetic rocks representing each lava deposit.

The team melted the synthetic rocks in a furnace to simulate the point in time when the deposits were lava, and not yet solidified as the rock. Then, the researchers dialed the temperature and pressure of the furnace up and down to effectively turn back the clock, simulating the lava's eruption from deep within the planet to the surface, in reverse.

Throughout these experiments, the team looked for tiny crystals forming in each molten sample, representing the point at which the sample turns from lava to rock. This represents the stage at which the planet's solid rocky core begins to melt, creating a molten material that sloshes around in Mercury's mantle before erupting onto the surface.

The team found a surprising disparity in the two samples: The older rock melted deeper in the planet, at 360 kilometres, and at higher temperatures of 1,650°C, while the younger rock melted at shallower depths, at 160 kilometres, and 1,410°C. The experiments indicate that the planet's interior cooled dramatically, over 240 degrees Celsius between 4.2 and 3.7 billion years ago — a geologically short span of 500 million years.

"Mercury has had a huge variation in temperature over a fairly short period of time, that records a really amazing melting process," Grove says.

The researchers determined the chemical compositions of the tiny crystals that formed in each sample, in order to identify the original material that may have made up Mercury's interior before it melted and erupted onto the surface. They found the closest match to be an enstatite chondrite, an extremely rare form of a meteorite that is thought to make up only about 2 per cent of the meteorites that fall to earth.

"We now know something like an enstatite chondrite was the starting material for Mercury, which is surprising because they are about 10 standard deviations away from all other chondrites," Grove says.

Grove cautions that the group's results are not set in stone and that Mercury may have been an accumulation of other types of starting materials. To know this would require an actual sample from the planet's surface.

Global, Evolving, and Historic Make-up of Malaria Species Uncovered

https://www.sciencedaily.com/releases/2016/06/160627124430.htm

Source: Sciencedaily/ New York University

"Plasmodium vivax is going to be the last malaria parasite standing," observes Jane Carlton, a professor in New York University's Department of Biology, who led the study. "Our findings show it is evolving in response to anti-malarial drugs and adapting to regional differences, indicating a wide range of approaches will likely be necessary to eliminate it globally."

"The DNA data show that P. vivax has clearly had a different history of association with global human populations than other malaria parasites, indicating that unique aspects of its biology may have influenced the ways in which it spread around the world," adds Daniel Neafsey, associate director of the Genomic Center for Infectious Disease at the Broad Institute, who generated the data and co-led the analysis.

P. vivax causes an estimated 15.8 million clinical malaria cases each year. However, it remains understudied because it is both less lethal than other species and because it has historically been difficult to analyze since it cannot be grown in the laboratory. Another challenge is separating the parasite's DNA from human DNA.

In their study, which appears in the journal *Nature Genetics*, the research team sequenced approximately 200 DNA samples of P. vivax collected from patients—the largest number of P. vivax genomes sequenced to date—in 11 countries, including Brazil, Colombia, India, Mexico, Myanmar, Papua New Guinea, Peru, and Thailand. The scientists were able to separate P. vivax DNA from its human host by using a set of unique 'sticky baits' that captured the parasite DNA, enabling the human DNA to be washed away.

The researchers collected patient samples through the International Centers of Excellence for Malaria Research, a global network of independent research centres in malaria-endemic settings that provide knowledge, tools, and evidence-based strategies to support in-country researchers working in a variety of settings, especially within governments and healthcare institutions.

The sequencing of the parasite's genome offered an array of new insights into the nature of P. vivax as it exists today and also served as a "genetic history book" of the studied regions:

- Central and South American P. vivax populations are very genetically diverse and distinct from all other contemporary P. vivax populations, suggesting that New World parasites may have been introduced by colonial seafarers and represent a now-eliminated European parasite population.
- Contemporary African and South Asian P. vivax populations are genetically similar, suggesting that South Asian P. vivax populations may have genetically mingled with European lineages during the colonial era—or, alternatively, reflect ancient connections between human populations in the Eastern Mediterranean, Middle East, and Indian subcontinent.
- The relatively homogeneous genetic makeup of P. vivax in Mexico reflects a steady decline of the disease in this country over the last decade, falling to under 10,000 cases.
- By contrast, the Papua New Guinea (PNG) population of P. vivax is very diverse relative to other P. vivax populations, with implications for developing different methods of control in this region of the world.
- P. vivax is significantly more genetically diverse than the more widely studied and deadlier malaria

species P. falciparum, which may make it more elusive to methods of control and thus more difficult to eliminate.

- Resistant forms of two genes associated with antimalarial drug resistance have swept through the global population.
- Several genes were identified as adapting to regional differences in the human host and mosquito vector—for example, a gene involved in evasion of the mosquito immune response that enabled the species to successfully adapt to development and transmission in New World mosquito species.

The research was conducted through the National Institute of Allergy and Infectious Diseases (NIAID)/National Institutes of Health (NIH) International Centers of Excellence for Malaria Research (U19AI089676, U19AI089681, U19AI089686, U19AI089672, U19AI089702) and Contract No. HHSN272200900018C, as well as supported by the National Council for Science and Technology Mexico (29005-M SALUD-2004-119), and the Victorian State Government Operational Infrastructure Support and the Australian Government (NHMRC IRIISS), among others.

Seeds of Black Holes Could Be Revealed by Gravitational Waves Detected in Space

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Source: Sciencedaily/ Durham University

Gravitational waves or ripple detectors can be used in identifying how some of the largest black holes of the universe were born.

Scientists led by Durham University's Institute for Computational Cosmology ran the huge cosmological simulations that can be used to predict the rate at which gravitational waves caused by collisions between the monster black holes might be detected.

The amplitude and frequency of these waves could unveil mass of the origin from which the first black holes developed since they were formed 13 billion years ago and provide further clues about what caused them and where they formed, the researchers said.

The study combined simulations from the EAGLE project — which aims to create a realistic simulation of the known Universe inside a computer — with a model to calculate gravitational wave signals.

Two detections of gravitational waves caused by collisions between supermassive black holes should be possible each year using space-based instruments such as the Evolved Laser Interferometer Space Antenna (eLISA) detector that is due to launch in 2034, the researchers said.

As eLISA will be in space — and will be at least 250,000 times larger than detectors on earth — it should be able to detect the much lower frequency gravitational waves caused by collisions between supermassive black holes that are up to a million times the mass of our sun.

Current theories suggest that the origin of these black holes were the conclusion of either the growth and destruction of the first generation of stars in the universe; collisions between stars in dense stellar clusters; or the

direct collapse of extremely massive stars in the early universe.

As each of these theories anticipated different initial masses for the origin of supermassive black hole seeds, the collisions would produce different gravitational wave signals.

This means that the potential detections by eLISA could help pinpoint the mechanism that helped create supermassive black holes and when in the history of the universe they formed.

Lead author Jaime Salcido, PhD student in Durham University's Institute for Computational Cosmology, said: "Understanding more about gravitational waves means that we can study the universe in an entirely different way.

"These waves are caused by massive collisions between objects with a mass far greater than our sun.

"By combining the detection of gravitational waves with simulations we could ultimately work out when and how the first origin of supermassive black holes formed."

Co-author Professor Richard Bower, of Durham University's Institute for Computational Cosmology, added: "Black holes are fundamental to galaxy formation and are thought to sit at the centre of most galaxies, including our very own Milky Way.

"Discovering how they came to be where they are is one of the unsolved problems of cosmology and astronomy.

"Our research has shown how space based detectors will provide new observations into the nature of supermassive black holes."

Gravitational waves were first predicted 100 years ago by Albert Einstein as part of his Theory of General Relativity.

The waves are concentric ripples caused by violent events in the universe that squeeze and stretch the fabric of space-time but most are so weak they cannot be detected.

LIGO detected gravitational waves using ground-based instruments, called interferometers, that use laser beams to pick up subtle disturbances caused by the waves.

eLISA will work in an analogous way, detecting the small variations in separation between three satellites that will orbit the sun in a triangular pattern associated by beams from lasers in each satellite.

Recently, it was reported that the LISA Pathfinder, the precursor to eLISA, had successfully established the technology that opens the door to the development of a large space observatory accomplished of detecting gravitational waves in space.

Scientists just Made it Cheaper to Produce Hydrogen from Water

https://www.sciencedaily.com/releases/2016/06/160627095937.htm

Source: Sciencedaily/ KTH The Royal Institute of Technology

A hydrogen-fuel economy could finally become a reality with the innovative discovery of a cheap, stable and efficient way of extracting hydrogen from water.

If a cheap, stable and efficient way could be found to produce hydrogen from water, a hydrogen-fuel economy could definitely become a reality.

Scientists at KTH Royal Institute of Technology in Stockholm now addresses that they have unlocked one major barrier to exploiting this renewable energy source.

Since the highly-efficient catalysts for electrochemical oxidation, or "water splitting," are expensive crucial metals, the research team led by KTH Professor Licheng Sun is one of many worldwide searching for cheaper alternatives. Sun had earlier developed molecular catalysts for water oxidation (*Nature Chem*. 2012, Vol. 4, pp. 418-423) with an efficiency impending to that of natural photosynthesis.

His team reported in *Nature Communications* that it has discovered that a modern substantial composed of common earth-abundant elements could be used as a catalyst for water splitting, which could help change the economics of large-scale hydrogen fuel production.

Researcher Ke Fan mentions that the new material is a monolayered double hydroxide involving nickel and vanadium, which offers a state-of-art electrocatalyst for water oxidation. The low-cost, highly efficient nickel-vanadium monolayer outperforms other electrocatalysts that are composed of non-precious materials, Fan says. And it attempts an ambitious, economical, alternative to catalysts that trust on more overpriced, crucial materials, such as iridium oxide (IrO2) or ruthenium oxide (RuO2).

"This is the first time that the metal, vanadium, has been used to dope nickel hydroxide to form a water oxidation catalyst, and it works very well — even beyond our expectations," Fan says. "No doubt this material can extremely expand the extension of non-precious metal elements of electrocatalysts, and it opens new areas for water splitting."

One possibility the discovery hikes is the large-scale production of hydrogen fuel utilizing Sun's catalyst.

The substance possesses a layered structure with monolayer nickel-vanadium oxygen polyhedron connected together with a thickness below 1 nanometer, interpret researcher Hong Chen.

"This monolayer also features in enhancing the active surface area, but also enhances the electron transfer within the material," Chen says.

Sun expects the research to "open a new area of more economical water oxidation catalysts, featuring stability and efficiencies that equal or even surpass some of today's best catalysts including RuO2 and IrO2."

Super-slow Circulation Allowed World's Oceans to Store Huge Amounts of Carbon During Last Ice Age

https://www.sciencedaily.com/releases/2016/06/160627094834.htm

Source: Sciencedaily/ University of Cambridge

The manner the ocean carried heat, nutrients and carbon dioxide at the roof of the previous ice age, about several thousand of years ago, is significantly different than what has formerly been suggested, according to two new studies. The conclusions suggest that the brisk ocean circulated at a very sluggish rate, which empowers it to accumulate much more carbon for much longer than the current ocean.

Using the information contained within the shells of tiny animals known as foraminifera, the researchers, led by the University of Cambridge, looked at the characteristics of the seawater in the Atlantic Ocean during the previous ice age, including its ability to store carbon. Since atmospheric CO_2 levels during the period were about a third lower than those of the pre-industrial atmosphere, the researchers were attempting to find if the extra carbon not present in the atmosphere was stored in the deep ocean rather.

They settle that the deep ocean circulated at a much gradual rate at the peak of the previous ice age than had previously been suggested, which is one of the reasons why it was able to store much more carbon for much longer periods. That carbon was accumulated as organisms from the surface ocean expire and sank in the deep ocean where their bodies dissolved, releasing carbon that was in effect 'trapped' there for thousands of years. Their results are reported in two separate papers in *Nature Communications*.

The ability to reconstruct past climate change is an important part of understanding why the climate of today behaves the way it does. It also helps to predict how the planet might respond to changes made by humans, such as the enduring emission of large quantities of CO_2 into the atmosphere.

The world's oceans work like a giant conveyor belt, transporting heat, nutrients, and gases around the globe. In today's oceans, warmer waters travel northwards along currents such as the Gulf Stream from the equatorial zones towards the pole, becoming saltier, colder and denser as they go, causing them to sink to the bottom. These deep waters flow into the ocean basins, eventually ending up in the Southern Ocean or the North Pacific Ocean. An entire loop can take as long as 1000 years.

"During the period we're looking at, large amounts of carbon were likely carried from the surface ocean to the deep ocean by organisms as they expire, sunk and dissolved," said Emma Freeman, the main author of one of the papers. "This operation discharged the carbon the organisms contained into the deep ocean waters, where it was trapped for thousands of years, due to the very slow circulation."

Freeman and her co-authors used radiocarbon dating, a technique that is more commonly used by archaeologists, in the procedure to determine how old the water was in different parts of the ocean. Using the radiocarbon information from tiny shells of foraminifera, they found that carbon was stored in the slowly-circulating deep ocean.

In a separate study led by Jake Howe, also from Cambridge's Department of Earth Sciences, researchers studied the neodymium isotopes contained in the foraminifera shells, a method which works like a dye tracer, and came to a similar conclusion about the amount of carbon the ocean was able to store.

"We found that during the peak of the previous ice age, the deep Atlantic Ocean was filled not just with southern-sourced waters as previously thought, but with northern-sourced waters as well," said Howe.

What was previously interpreted to be a layer of southern-sourced water in the deep Atlantic during the previous ice age was in fact shown to be a mixture of slowly circulating northern- and southern-sourced waters with a large amount of carbon stored in it.

"Our research looks at a time when the world was much colder than it is now, but it's still important for understanding the effects of changing ocean circulation," said Freeman. "We need to understand the dynamics of the ocean in order to know how it can be affected by a changing climate."

The research was funded in part by the Natural Environment Research Council (NERC), the Royal Society and the Isaac Newton Trust.

Robots Come to Each Other's Aid When they Get the Signal

https://www.sciencedaily.com/releases/2016/06/160627095637.htm

Source: Sciencedaily/ KTH The Royal Institute of Technology

Sometimes all it takes to receive help from someone is to wave at them, or point. Now the same is true for robots. Researchers at KTH Royal Institute of Technology in Sweden have completed work on an EU project aimed at enabling robots to coordinate with each other on difficult tasks, by using body language.

Dimos Dimarogonas, an associate professor at KTH and project coordinator for RECONFIG, adds the research project has developed agreements that enable robots to ask for help from each other and to observe when other robots need cooperation — and change their strategy accordingly.

"Robots can pause what they're doing and go over to collaborate with another robot which has asked for support," Dimarogonas says. "This will mean flexible and dynamic robots that act much more like humans — robots capable of constantly facing new choices and that are competent enough to make decisions."

As self-governing machines take on more responsibilities, they are bound to encounter tasks that are too big for a single robot. Shared work could include lending an extra hand to lift and carry something, or holding an object in place, but Dimarogonas declare the concept can be proportioned up to include any figure of functions in a home, a factory or other kinds of workplaces.

The project was completed in May 2016, with project partners at Aalto University in Finland, the National Technical University of Athens in Greece, and the École Centrale Paris in France.

In a series of filmed presentations, the researchers establish the newfound capabilities of several off-the-shelf self-governing machines, including NAO robots. One video shows a robot pointing out an object to another robot, conveying the message that it needs the robot to lift the item.

Dimarogonas announces that common perception among the robots is one key to this collaborative work.

"The visual feedback that the robots receive is translated into the same symbol for the same object," he says. "With advanced vision technology they can understand that one body is the same from different angles. That is translated to the same symbol one layer up to the decision-making — that it is a thing of interest that we need to transport or not. In other words, they have non-cognitive agreement."

In another manifestation two robots carry an object together. One leads the other, which senses what the lead robot wants by the force it exerts on the object, he adds.

"It's just like if you and I were carrying a table and I knew where it had to go," he says. "You would sense which direction I wanted to go by the way I turn and push, or pull."

The crucial point is that all of these behaviour take place without human interaction or support, he says.

"This is done in real time, autonomously," he says. The project also uses a novel communication agreement that sets it apart from other collaborative robot concepts. "We minimize communication. There is a symbolic communication protocol, but it's discontinuous. When support is needed, a call for help is broadcast and a helper robot transfers the information to another robot. But it's a one-time opportunity."

Artificial Intelligence May Aid in Alzheimer's Diagnosis

https://www.sciencedaily.com/releases/2016/07/160706091455.htm

***Source*: Sciencedaily/ Radiological Society of North America**

Machine learning is a type of artificial intelligence that allows computer programs to learn when exposed to new data without being programmed. Now, researchers in The Netherlands have coupled machine learning methods with a special MRI technique that measures the perfusion, or tissue absorption rate, of blood throughout the brain to detect early forms of dementia, such as *mild cognitive impairment (MCI)*, according to a new study published online in the journal *Radiology*.

"MRI can be advantageous with the diagnosis of Alzheimer's disease," said principal investigator Alle Meije Wink, Ph.D., from the VU University Medical Centre in Amsterdam. "However, the early diagnosis of Alzheimer's disease is problematic."

Scientists have long known that Alzheimer's disease is a continuous process and that the brain undergoes functional changes before the structural changes associated with the disease show up on imaging results. Physicians have no definitive way of analysing who has early dementia or which cases of mild cognitive deterioration will progress to Alzheimer's disease.

"With definite diagnostic MRI, we can see advanced Alzheimer's disease, such as atrophy of the hippocampus," Dr. Meije Wink said. "But at that point, the brain tissue is gone and there's no way to build up it. It would be helpful to recognize and identify the disease before it's too late."

For the new study, the researchers applied machine learning methods to special type of MRI called arterial spin labeling (ASL) imaging. ASL MRI is used to create images called perfusion maps, which show how much blood is delivered to specific regions of the brain.

The automated machine learning program is taught to recognize patterns in these maps to distinguish among patients with varying levels of cognitive impairment and predict the stage of Alzheimer's disease in new (unseen) cases.

The study involves 260 of 311 participants from the Alzheimer Center of the VU University Medical Center dementia cohort who underwent ASL MRI between October 2010 and November 2012.

The study group included 100 patients diagnosed with probable Alzheimer's disease, 60 patients with mild cognitive impairment

(MCI) and 100 patients with subjective cognitive decline (SCD).

SCD and MCI are examined to be early stages of the dementia process and are diagnosed based on the severity of subjective symptoms, including memory loss and thought- and judgement-making difficulties.

The self-generative system was able to categorize adequately among candidates with Alzheimer's disease, MCI and SCD. Using classifiers based on the automated machine learning training, the researchers were then able to predict the Alzheimer's diagnosis or progression of single patients with a high degree of accuracy, ranging from 82 per cent to 90 per cent.

"ASL is a promising alternative functional biomarker for the early diagnosis of Alzheimer's disease," Dr. Meije Wink said.

He added that the application of automated machine learning methods would be useful as a potential screening tool.

"ASL MRI can diagnose brain variations that appear early in disease process, when there's a window of opportunity for intervention," Dr. Meije Wink said. "If the disease process from SCD to MCI to Alzheimer's disease could be deflected or slowed, this technique could play a vital role in shielding."

Replacing Oil with Wood for the Production of Chemicals

https://www.sciencedaily.com/releases/2016/07/160706091729.htm

Swiss National Science Foundation (SNSF)

Petroleum means fuel, but not only: petrochemicals are a core component of the chemical industry. In the absence of oil, there would be no plastics and few pharmaceuticals or fertilisers. Looking for a renewable resource as an alternative to oil will be vital to look the foreseeable deterioration in oil extraction.

Two research projects of the National Research Programme "Resource Wood" (NRP 66) have made significant advances towards replacing oil with biomass derived from plants, in particular from wood. Their goals are complementary, as each one uses one of the two main constituents of wood: cellulose and lignin. These are the two most common organic components on earth and, importantly, are renewable.

Sviatlana Siankevich of EPFL has designed new catalytic processes to efficiently transform cellulose into hydroxymethylfurfural (HMF), a very important precursor for the production of plastics, fertilisers or biofuels. Inspired by the action of fungi degrading rotting wood, the team of Philippe Corvini at FHNW in Muttenz (BL) has selected enzymes capable of cutting lignin into aromatic compounds useful for making solvents, pesticides, plastics such as polystyrenes as well as active pharmaceutical ingredients.

Chemicals Instead of Paper

Cellulose is a long chain of carbohydrate (sugar) molecules and accounts for about two-thirds of wood's weight. "It is mainly used for paper production, and the residuals could be better valorised by being transformed into useful chemicals," says Sviatlana Siankevich of EPFL's Institute of Chemical Sciences and Engineering. With colleagues from Queen's University in Canada and the National University of

Singapore, the EPFL team led by chemist Paul Dyson synthesised several types of ionic liquids (molten salts) to convert cellulose into HMF, an important molecule for the production of commodity chemicals. In a single step, their reaction reached a 62% yield, a new record.

"Our procedure operates at mild conditions, that is, without very high temperatures or pressure or strong acids," says Siankevich. "We've also been able to reduce the amount of undesired by-products, an important point if the reaction is to be scaled up for industrial processes. Our process can work with wood, but it's often easier to use cellulose extracted from herbaceous plants."

Greener Chemistry

At the Fachhochschule Nordwestschweiz (FHNW) in Muttenz, Philippe Corvini and his PhD student Christoph Gasser are developing ways to use lignin, a long molecule which gives trees their rigidity and makes up around 15%-40% of the wood content. "Until now, lignin was not very much valorised, but often simply burned," says Corvini. "But it can be cut into aromatic structures, molecules based on the famous carbon hexagon ubiquitous in organic chemistry. These components represent huge volumes for the chemical industry, and have been so far almost exclusively obtained from petroleum. Lignin is presently the most serious alternative."

Some fungi secrete a combination of enzymes to degrade lignin and chop it into smaller pieces. Corvini's team at FHNW screened the combinations of dozens of such enzymes to select the most efficient. By adding a further catalytic step, they managed to transform 40% of the lignin into very small molecules such as vanillin. The process is of interest to the chemical industry, and collaboration with a lignin producer is already underway. "Most of the lignin today is obtained from wheat or rice straw," says Corvini. "But soft wood such as spruce could prove useful as its lignin is easy to break down."

The FHNW team also developed a way to reuse the enzymes. "We have attached them onto iron nanoparticles coated with silica, explains the researcher. After the reaction, we simply approach with a magnet to attract the particles and recover the enzymes." As these can be reused up to ten times, the energy and resources needed to produce them is significantly reduced and fits well into the concept of "green chemistry."

All of the Wood

To be economically viable, wood as a replacement for petrochemicals must be used to the greatest extent possible. "Extracting only one component from wood in small quantity is not enough," says Sviatlana Siankevich. "We need to find complementary processes to use all of it." But more aspects must be considered to assess whether wood can serve as an economically viable substitute for oil. A third project of NRP 66 has recently carried out a sustainability assessment of the production of succinic acid, another important chemical, from wood residues. The study from ETH Zurich and EPFL shows that smart process design can lead to energy savings and environmental benefits, key factors for biorefineries to be competitive.

Children's Purchasing Behaviour 'Significantly Impacted' by Social Media, Mobile Apps

https://www.sciencedaily.com/releases/2016/07/160706114619.htm

***Source*: Sciencedaily/ University of Leicester**

Exposure to prompts to make in-app purchases in mobile games has a significant impact on children's purchasing behaviour, according to a recent study funded by the European Commission involving Dr Giuseppe Veltri, who now works at the University of Leicester Department of Media Communication.

The study examined the impact on children of in-game adverts in advergames, mobile apps and social media games.

The results suggest that children are often exposed to a number of problematic marketing practices in online games, mobile apps and social media sites which are not always understood by the child consumer.

The researchers found that out of the 25 most popular online games, all 'advergames', all social media games and half of the games provided through popular application platforms contained embedded or contextual advertisements.

Dr Giuseppe Veltri, Senior Lecturer in Social Psychology of Communication at the University of Leicester Department of Media and Communication said: "This is a significant study on an already pressing policy issue. The study demonstrated the large impact that online marketing practices can have on children and the difficulty in managing such effects from the perspective of parents and sheds light on their coping strategies.

"Both these aspects represent a crucial input for policymakers interested in regulating this area."

Dr Veltri was a member of the London School of Economics and partners consortium in which they were one of the experts that carried out the study.

The study finds that across Europe children do not receive an equal level of protection from the adverse effects of online marketing, given that marketing to children is regulated in a slightly different manner between countries and because parents apply different models of oversight of their children's online activities.

In general, most parents involved in the study did not see online marketing targeting their children as a major risk, and thought that their children are not affected.

For example, parents in France were found to intervene less in their children's online activities, while Swedish parents are more actively engaged in their children's online activities and apply more restrictions.

The research suggests that although parents have an important role in protecting their children online, they are often not prepared to do so.

The findings are based on data collected through various methods including behavioural experiments with children in two countries (The Netherlands and Spain); focus groups with children and with parents in eight countries (UK, Spain, Italy, France, Poland, The Netherlands, Germany

and Sweden); a survey with parents in the same eight countries; an in-depth analysis of the most popular games in the main online platforms; a literature review, and a regulatory review covering the 28 EU Member States, Norway and Iceland.

The study confirms the need for a strong and harmonised protection of children as consumers, and it brings new evidence that advances the understanding of children as potentially vulnerable consumers and of marketing practices that can be considered unfair from the perspective of child consumers.

The study also provides evidence to support the ban on product placement in programmes with a significant children audience in the proposed Directive on Audio-Visual Media Services, and is relevant for the ongoing review of EU consumer and marketing law.

Science Could Help Search for the Next Tennis Champions

https://www.sciencedaily.com/releases/2016/07/160706131922.htm

***Source*: Sciencedaily/ University of Bath**

Grouping young tennis players according to their physical maturity rather than their chronological age could help us develop future tennis champions, says research by the University of Bath.

Boys and girls can vastly vary in their rates of growth and maturity during adolescence. Those that mature early are taller, quicker, bigger and stronger, giving them a significant advantage over their late maturing peers. This means that later maturing players are often overlooked in the elite tennis selection process.

Now the Lawn Tennis Association (LTA) is collaborating with scientists at the University of Bath to use statistics to avoid selection bias towards early maturing players.

Dr Sean Cumming, Senior Lecturer in Health at the University of Bath commented: "Tennis is a sport that favours youth who are taller and mature earlier than their peers. Our data show that this selection bias impacts girls from the age of 10 and boys from the age of 12.

"Every extra inch in height of a player increases the velocity of their serve by five per cent. At the elite level, it is quite common to find junior players, especially adolescent boys, who are six foot or greater in height.

"The challenge for those working with young tennis players is to look beyond differences in maturity, and recognise those players who may have the greatest potential for success as an adult. While early maturing boys and girls have initial advantages, the pressure to win can lead them to play to their physical strengths at the expense of their technical development.

"In contrast, talented, yet late maturing players might be excluded or overlooked by talent spotters on the basis of physical characteristics that are not fully realised until adulthood."

The research team, which includes mathematicians from Bath's Institute for Mathematical Innovation, is developing new statistical methods to allow practitioners

to better assess and account for individual differences in biological maturity and help ensure players are evaluated on the basis of their physical development, and not just their chronological age.

Gill Myburgh, a Strength and Conditioning coach at the LTA and part-time PhD student at Bath, said: "Being able to more accurately assess and account for individual differences in growth and maturity, is really important when assessing talent. It also helps us design and implement more effective and developmentally appropriate training programmes.

"Growth spurts can increase the risk of injuries, so monitoring players' growth trajectories and adjusting their training programmes accordingly is vital in getting the best out of all players, and could be key in spotting and nurturing the next UK tennis star."

Myburgh also sees potential benefits in periodically matching players by maturity status, rather than age, in training and competition. This process, known as bio-banding, is currently being trialled by a number of Premier League football academies.

"Having early maturers occasionally train with and compete against players who are older but of similar maturity level stretches them as they can no longer rely on their physical advantages.

"It challenges them more and encourages the development of their tactical, technical and psychological skills. Bio-banding also provides late maturing players with more opportunity to use their skills and demonstrate their true potential. Of course, when implementing such strategies it is equally important to consider psychological and technical development, as not all players will benefit from playing in an older or younger age group."

The team has recently published its research in the journal *Pediatric Exercise Science*.

The University of Bath's research team is also investigating using bio-banding techniques in other disciplines such as rugby, football and ballet.

Your Smartwatch is Giving Away Your ATM PIN

https://www.sciencedaily.com/releases/2016/07/160706131951.htm

***Source*: Sciencedaily/ Binghamton University**

Wearable devices can give away your passwords, according to new research.

In the paper "Friend or Foe?: Your Wearable Devices Reveal Your Personal PIN" scientists from the Stevens Institute of Technology and Binghamton University combined data from embedded sensors in wearable technologies, such as smartwatches and fitness trackers, along with a computer algorithm to crack private PINs and passwords with 80-percent accuracy on the first try and more than 90-percent accuracy after three tries.

Yan Wang, assistant professor of computer science within the Thomas J. Watson School of Engineering and Applied Science at Binghamton University is a co-author of the study along with the lead researcher, his advisor Yingying Chen, from the Stevens

Institute of Technology. There are three other students from Stevens Institute of Technology working on this project together. The group is collaborating on this and other mobile device-related security and privacy projects.

"Wearable devices can be exploited," said Wang. "Attackers can reproduce the trajectories of the user's hand then recover secret key entries to ATM cash machines, electronic door locks and keypad-controlled enterprise servers."

"This was surprising, even to those of us already working in this area," says the lead researcher Chen, a multiple time National Science Foundation (NSF) awardee. "It may be easier than we think for criminals to obtain secret information from our wearables by using the right techniques.

With extensive real experiments, the team was able to record millimeter-level information of fine-grained hand movements from accelerometers, gyroscopes and magnetometers inside the wearable technologies regardless of a hand's pose. Those measurements lead to distance and direction estimations between consecutive keystrokes, which the team's "Backward PIN-sequence Inference Algorithm" used to break codes with alarming accuracy without context clues about the keypad.

According to the research team, this is the first technique that reveals personal PINs by exploiting information from wearable devices without the need for contextual information.

The findings are an early step in understanding security vulnerabilities of wearable devices. Even though wearable devices track health and medical activities, their size and computing power doesn't allow for robust security measures, which makes the data within more vulnerable to attack.

The team is working on countermeasures for the problem in the current research. An initial approach is to, "inject a certain type of noise to data so it cannot be used to derive fine-grained hand movements, while still being effective for fitness tracking purposes such as activity recognition or step counts."

The team also suggests better encryption between the wearable device and the host operating system.

The paper was published in Proceedings of — and received the "Best Paper Award" — the 11th Association for Computing Machinery (ACM) Asia Conference on Computer and Communications Security (ASIACCS) in Xi'an China, (May, 2016)

Local Consumption, Global Consequences: Examining Impacts of an Interconnected World

https://www.sciencedaily.com/releases/2016/07/160706131926.htm

***Source*: Sciencedaily/ Yale School of Forestry and Environmental Studies**

Everything, from the food we eat to the clothes we wear to cars we drive, has global implications, requiring resources from distant places and generating pollution far from our homes. But while these impacts have been known for a long time, our understanding of the complex ripple effect throughout the global economy and on natural and social systems remains rudimentary.

In a new special issue, "Linking Local Consumption and Global Impacts," Yale's *Journal of Industrial Ecology* examines the virtual shrinking of distances between places — arising because of trade, telecommunication and travel — and the widening gap between where products are made, where they're used, and where the impacts occur.

The articles link consumption and/or production activities to a wide range of environmental impacts, including water, energy and land use; various pollutants; and economic and social indicators, such as child labour, social costs of carbon, and loss of human life.

"The focus is on 'tele-connected systems,'" said Prof. Klaus Hubacek of the University of Maryland and lead guest editor for the special issue. "This is a concept from atmospheric sciences referring to climate phenomena being related to one another at large distances. Recently, this idea has been used to represent the strengthening of connectivity between distant locations and, at the same time, the growing physical separation between places of consumption and production."

Highlights of the Issue

An assessment of the impacts of the 21st century Great Recession on income inequality and households' carbon footprint.

An examination of the global implications of China's future food demand.

Tracking of water footprints at the micro- and meso-scale through combining MRIO (multiregional input output analysis) and geographical information system (GIS).

An assessment of child labour's role in Indian production and global consumption.

A look at the unequal carbon exchanges of iconic US consumption items.

Discussion on the role of trade openness in the context of climate-change mitigation

An analysis of households' direct and indirect material, water, and land use requirements and GHG emissions.

Research that links a consumer expenditure survey to a global MRIO database to assess the carbon footprint for different household categories.

A global framework for reconciling top-down with bottom-up approaches for identifying and evaluating the effectiveness of different scenarios about the future.

"Much of the research in this special issue uses a technique called environmentally-extended multi-regional input-output analysis." said Reid Lifset, Editor in Chief of the *Journal of Industrial Ecology*. "This method, a hallmark of the field of industrial ecology, is especially well-suited for linking the local to the global because it allows tracing of supply chains and the attendant resource use and emissions within and across countries."

Radiocarbon Dating Suggests Joint Cartilage Can't Renew

https://www.sciencedaily.com/releases/2016/07/160706172034.htm

***Source*: Sciencedaily/ American Association for the Advancement of Science**

Using radiocarbon dating as a forensic tool, researchers have found that human cartilage rarely renews in adulthood, suggesting that

joint diseases may be harder to treat than previously thought.

The technique, which dates tissues by tracing radioactive carbon and measuring it against levels of carbon-14 in the atmosphere from the nuclear bomb testing in the 1950s and 1960s, reveals that cartilage is an essentially permanent tissue in healthy and osteoarthritic adults alike.

The findings may help explain the limited success of cartilage transplant and stem cell therapy for osteoarthritis, and may redirect treatment efforts to preventing cartilage disease and protecting joints from further damage. Whether cartilage, the tissue lining the surface of joints, regenerates or remains "fixed" throughout life is a subject of debate.

Less still is known about the effects of joint diseases on cartilage turnover.

Katja Heinemeier and colleagues turned to the bomb pulse method, which exploits the fact that all living things through their diet incorporate carbon-14 from the atmosphere.

During the Cold War, atmospheric levels of this carbon isotope spiked due to the testing of nuclear bombs, leaving a detectable imprint in all organisms living at the time. The technique has been used to estimate the age of fat, muscle, the eye lens, and other tissues.

Heinemeier, *et al.* now apply it to cartilage in knee joints from eight healthy and 15 osteoarthritic individuals born between 1935 and 1997. Across all individuals, the researchers detected virtually no formation of new collagen in cartilage, even in disease or under high loads, suggesting that the tissue is an essentially permanent structure.

The findings help explain why human cartilage has poor healing capacity after injury and present new challenges for treating osteoarthritis and other joint diseases.

Rapid Test for Pathogens: Could Be Used to Detect Diseases Used by Bioterrorists

https://www.sciencedaily.com/releases/2008/08/080821164611.htm

***Source*: Sciencedaily/ Kansas State University**

At present, bacteria, fungi or viruses can generally only be detected with certainty by way of elaborate laboratory tests or animal experiments. The food and pharmaceutical industries would like to have faster tests to check their products. Fraunhofer researchers are therefore developing a stick that works like a pregnancy test and quickly delivers a result. In the future, it is also to be used for detecting allergens and disease pathogens in the blood.

Researchers at the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart are developing a test which rapidly and cost-effectively identifies bacteria, fungi or viruses. It can be carried out directly in situ without laboratory equipment and specialist knowledge. "The ImmuStick can even detect pathogens outside the body — on medical devices or in hospital rooms for example. However, the technology would certainly also be of interest for testing human blood for germs or allergies," says Dr Anke Burger-Kentischer.

As Easy as a Pregnancy Test

The method works as simply as a pregnancy test. The ImmuStick is a test strip onto which

a few drops of fluid are applied. If the fluid contains pyrogens, fragments of pathogens, this is shown by a coloured strip in a viewing window. First of all, human immune receptors sensitive to certain pyrogens are applied to the surface of the stick. These are laboratory-produced immune receptors which are synthesised on the basis of the biological model. During production, at the docking point of the immune receptors to which the pyrogens normally bind, a type of placeholder is mounted which is marked with a dye. When drops of a fluid containing pyrogens are then applied to the test strip, the pyrogens rush to the docking point on the immune receptor. The placeholders marked with the dye migrate with the fluid through the test strip until they are visible in the viewing window. The colour signal thus indicates that pyrogens that have docked on the immune receptors are present.

The ImmuStick project was financed with money from the Discover program. In this way the Fraunhofer-Gesellschaft is supporting projects for the duration of one year in order to demonstrate the feasibility of a technology. The ImmuStick has passed this test. "We were able to show that it works very well for the bacterial pyrogen LPS. Together with industrial partners, we now want to develop it into a product," says project manager Burger-Kentischer. "We are currently testing further immune receptors that are specific for other pyrogens."

Detecting Blood Poisoning and Allergies

Currently envisaged are applications in the food and pharmaceuticals sector or in medical technology, as a complete absence of germs or pyrogens is required there. In principle, the ImmuStick would also be of interest for blood analysis. Pyrogens in the blood often lead to blood poisoning, sepsis, from which many people still die today, especially weakened intensive care patients. "However, blood is a special challenge as it is complex and contains many constituent parts. But in the medium term we are aiming at blood analysis," says Burger-Kentischer.

As pyrogens also include certain allergy trigger factors, an application here would also be conceivable. In the food and pharmaceutical industries, for example, it is important that products are free of allergens. With the ImmuStick these could be detected quickly, cost-effectively and simply. Costly and laborious laboratory tests would therefore no longer be needed or could be supplemented. At present the IGB researchers are seeking cooperation partners who want to further develop the ImmuStick to make it ready for the market.

Pyrogens become a problem when hygiene is of particular importance — in the food and pharmaceutical industries for example, or on intensive care wards in hospitals. Especially people with weakened immune systems can become severely ill. For this reason, tests are frequently carried out and the surfaces of machines or medical devices are tested for pyrogens using swabs. However, to date these tests have been costly and laborious as pyrogens can only be detected with laboratory equipment. A widely used standard test is the detection of LPS, a structure that is present in the membrane of certain bacteria. At present this test takes up around two hours. Other pyrogens can even only be detected in animal experiment.

From Climate Killer to Fuels and Polymers

https://www.sciencedaily.com/releases/2016/07/160704083006.htm

***Source*: Sciencedaily/ Ruhr-Universitaet-Bochum**

Researchers have discovered a catalyst that performs highly selective conversion of the greenhouse gas carbon dioxide into ethylene — an important source material for the chemical industry. In the journal *Nature Communications*, a team headed by Prof Dr Beatriz Roldan Cuenya from Ruhr-Universität Bochum describes how plasma-treated copper can be used for this purpose.

Catalysts traditionally used for the electrochemical conversion of carbon dioxide into useful chemicals were not efficient enough. The reason: the materials do not have high selectivity; they produce a little ethylene and too many unwanted side products. This has now been changed.

More Selectivity through Plasma Treatment

PhD student Hemma Mistry from the Institute for Experimental Physics IV in Bochum used copper films treated with oxygen or hydrogen plasmas as catalysts. Through these plasma treatments, she altered the properties of the copper surface, rendering it rougher or less rough, for example, and oxidizing the material. The researcher varied the plasma parameters systematically until she hit on the optimal surface properties.

Her best catalyst boasts a higher ethylene production rate than traditional copper catalysts. At the same time, it acts in a highly selective manner, which means that the amount of unwanted side products is considerably reduced. "It's a new record for this material," concludes Beatriz Roldan Cuenya.

Mechanism Decoded

The researchers also identified the reason why this form of plasma treatment has been successful. Using synchrotron radiation, they analysed the copper film's chemical state during the catalysis of the reaction. Through these measurements, they detected the cause of the higher ethylene selectivity. The key component was positively charged copper ions at the catalyst surface.

It had been assumed that copper can only exist in its metallic form under reaction conditions. The researchers' discovery has now disproved this assumption, and their findings were confirmed by additional microscopic analysis. "The results open up new possibilities for designing catalysts on the nanoscale with specific activity and selectivity," says Beatriz Roldan Cuenya.

New Technology Could Deliver Drugs to Brain Injuries

https://www.sciencedaily.com/releases/2016/06/160628114832.htm

***Source*: Sciencedaily/ Sanford Burnham Prebys Medical Discovery Institute**

A new study led by scientists at the Sanford Burnham Prebys Medical Discovery Institute (SBP) describes a technology that could lead to new therapeutics for traumatic brain injuries. The discovery, published in *Nature Communications*, provides a means of homing drugs or nanoparticles to injured areas of the brain.

"We have found a peptide sequence of four amino acids, cysteine, alanine, glutamine, and lysine (CAQK), that recognizes injured brain tissue," said Erkki Ruoslahti, M.D., Ph.D., distinguished professor in SBP's NCI-Designated Cancer Center and senior author of the study. "This peptide could be used to deliver treatments that limit the extent of damage."

About 2.5 million people in the US sustain traumatic brain injuries each year, usually resulting from car crashes, falls, and violence. While the initial injury cannot be repaired, the damaging effects of breaking open brain cells and blood vessels that ensue over the following hours and days can be minimised.

"Current Interventions for acute brain injury are aimed at stabilising the patient by reducing intracranial pressure and maintaining blood flow, but there are no approved drugs to stop the cascade of events that cause secondary injury," said Aman Mann, Ph.D., postdoctoral researcher in Ruoslahti's lab and the study's co-first author, together with Pablo Scodeller, Ph.D.

More than one hundred compounds are currently in preclinical tests to lessen brain damage following injury. These candidate drugs block the events that cause secondary damage, including inflammation, high levels of free radicals, over-excitation of neurons, and signaling that leads to cell death.

"Our goal was to find an alternative to directly injecting therapeutics into the brain, which is invasive and can add complications," explained Ruoslahti. "Using this peptide to deliver drugs means they could be administered intravenously, but still reach the site of injury in sufficient quantities to have an effect."

The CAQK peptide binds to components of the meshwork surrounding brain cells called chondroitin sulfate proteoglycans. Amounts of these large, sugar-decorated proteins increase following brain injury.

"Not only did we show that CAQK carries drug-sized molecules and nanoparticles to damaged areas in mouse models of acute brain injury, we also tested peptide binding to injured human brain samples and found the same selectivity," added Mann.

"This peptide could also be used to create tools to identify brain injuries, particularly mild ones, by attaching the peptide to materials that can be detected by medical imaging devices," Ruoslahti commented. "And, because the peptide can deliver nanoparticles that can be loaded with large molecules, it could enable enzyme or gene-silencing therapies."

This platform technology has been licensed by a startup company, AivoCode, which was recently awarded a Small Business Innovation Research (SBIR) grant from the National Science Foundation for further development and commercialisation.

Ruoslahti's team and their collaborators are currently testing the applications of these findings using animal models of other central nervous system (CNS) injuries such as spinal cord injury and multiple sclerosis.

Researchers Identify Possible Link between the Environment and Puberty

https://www.sciencedaily.com/releases/2016/06/160628114122.htm

***Source*: Sciencedaily/ University of Copenhagen The Faculty of Health and Medical Sciences**

Danish researchers have discovered a feasible epigenetic network between the environment and pubertal timing. To a large measure, pubertal timing is genetic, but the underlying genetic causes are still unexplored. Researchers have now examined how chemical alterations of the human genome (so-called epigenetic alterations) change when girls and boys enter puberty. The results indicate that such epigenetic changes are involved in defining the onset of puberty.

Danish girls' pubertal onslaught has decreased from 11 to 10 years. Similar, but less pronounced, variations have been detected in boys. This has led researchers to investigate the involvement of genetics and recognize that genes are not alone in influencing a child's pubertal timing.

In this new investigation from EDMaRC at Rigshospitalet, Copenhagen, researchers therefore concentrate on the role of epigenetics and have found a number of regions in the human genome, which is controlled epigenetically during puberty. The researchers found that these epigenetic changes cause the upregulation of genes that are important for pubertal development. One of the newly discovered 'puberty genes' is TRIP6 (Thyroid Hormone Receptor Interactor 6), which is progressively disclosed through puberty, due to alterations in the epigenetic regulation of the gene.

Epigenetics is a dominant mechanism by which our environment communicates with our genes. Environmental and lifestyle factors in the broadest sense can influence the epigenetic regulation of genes and thereby control whether, where and to what extent the genes are expressed. The identified epigenetic alterations during puberty are therefore our best lead towards understanding how environmental factors can influence pubertal onset.

"To our intelligence, this study is the first to determine how the environment can affect the pubertal onset in humans. It gives us a significant insight in to the crucial role of epigenetic factors on our reproductive development," says Professor Anders Juul, senior author of the study.

"We've seen a tendency of especially girls starting puberty earlier than before and this study emphasises the importance of understanding the role of environmental impact on pubertal development," he adds.

Highly precise changes in methylation of a child's DNA could discriminate children according to whether they had entered puberty or not and thus may be used to predict a child's pubertal phase.

"Changes in the DNA methylation patterns can be caused by many different factors. However, we could see very specific changes when children went through puberty, and have afterwards shown that this also leads to alterations in the expression of the methylated genes," says Senior Researcher in epigenetics Kristian Almstrup, who led the study.

2009 Swine Flu Pandemic Originated in Mexico, Researchers Discover

https://www.sciencedaily.com/releases/2016/06/160627160935.htm

***Source*: ScienceDaily/The Mount Sinai Hospital / Mount Sinai School of Medicine**

The 2009 swine H1N1 flu pandemic – main cause for more than 17,000 deaths worldwide

– firstly arises in pigs from a very small area in central Mexico, a research team headed by investigators at the Icahn School of Medicine at Mount Sinai is reporting.

The scientists add their findings, published in the special journal *eLife*, represent the first time that the cause of an influenza pandemic virus has been monitored in such detail.

Researchers used advance genetic investigation to search for the proper location and the main molecular transformations that allowed a pig influenza virus to transfer into humans. They establish that the virus responsible was a mix of one North American swine virus that had jumped between birds, humans, and pigs, and a second Eurasian swine virus, that circulated for more than 10 years in pigs in Mexico before jumping into humans. Previously, the most closely related ancestor viruses to the 2009 H1N1 virus were identified in Asian swine, but they were not as close genetically to the human 2009 pandemic H1N1 virus as the swine Mexican isolates found in this study.

The only other H1N1 pandemic flu known to date was the 'Spanish flu' of 1918 that killed between 50 and 100 million people — 3 to 5 per cent of the world's population.

Influenza viruses infect up to 500 million people annually.

"Knowing where and how an animal influenza virus infects humans and spreads all over the world helps us understand how we can reduce risk of these pandemics," says the study's senior author, Adolfo García-Sastre, PhD, Director of the Global Health and Emerging Pathogens Institute, Irene and Dr Arthur M. Fishberg Chair and Professor of Medicine (Infectious Diseases), and Professor of Microbiology at the Icahn School of Medicine at Mount Sinai.

Finding the actual location of the 2009 swine flu, known as an A/H1N1 pathogen, contribute a note of caution to evolving efforts to track problematic animal and bird viruses, Dr Garcia-Sastre says. "This virus came from, and was confined to, a very small geographic area and had been there 10 years before one emergent strain gained the capacity to infect humans," he says. "The virus was completely under the radar."

Dr Garcia-Sastre directs the Icahn School of Medicine's Center for Research on Influenza Pathogenesis, one of five National Institutes of Health (NIH) Centers of Excellence for Influenza Research and Surveillance. In association with the NIH and Avi-Mex, a Mexican veterinarian company, he and his team obtained 58 perfect-genome arrangements from influenza A viruses collected in the Mexican pigs and found viral arrangements formally not known to survive in Mexico or in any other part of the world.

Flu viruses have eight mini chromosomes and when two distinct strains infect the same cell they can swap genetic segments — a process called reassortment. "All the pandemic flu viruses that we have tracked have had reassortments," adds Dr. Garcia-Sastre.

The 2009 A/H1N1 was also a subordinate of two different strains of swine influenza — one that had been circulating in Europe and Asia and another that was circulating in the Americas, especially North America. "There is a lot of surveillance in North American pigs, and we know that this virus was actually a reassortment that occurred years ago between a bird (avian), human and a swine virus," he says.

The 2009 swine virus was therefore a "quadruple" reassortment, Dr. Garcia-Sastre says.

They also discovered that the ancestor virus had been present in the pigs in central Mexico for atleast 10 years before a strain was generated that could jump into humans, and that the parent strains still exist in the pigs there today. The findings make sense, he says, because the first human flu infections were seen in Mexico before the 2009 pandemic transmitted rapidly to the United States and then around the globe.

"Part of the complication in determining origin of pandemic influenzas is that the virus had been silent for so long," he says. "This is accurate for all former pandemics. The actual precursors of the viruses are unsure — we know there are reassortments but which ones and where the reassortment took place has been unclear."

By solving the origins and the reassortments that led to the 2009 A/H1N1 pandemic, researchers might be able to study existing "brothers and sisters" of the virus to understand the type of alterations needed to allow a virus to jump into humans.

Worldwide surveillance of active flu in pigs is vital because swines are a common global commodity, Dr Garcia-Sastre says. "We need to examine the viruses that are circulating, and try to stop combining influenza strains from different geographic locations," he says. "This investigation also shows that you cannot overlook small geographic areas with pig farms — places in which the 2009 pandemic arose and which the next, perhaps more severe global flu, may come from."

Biologists Explain Function of Pentagone

https://www.sciencedaily.com/releases/2016/06/160628141235.htm

***Source*: ScienceDaily/ BIOSS - Centre for Biological Signalling Studies**

How do the cells in a human embryo know where they are located in the body and how they should develop? Why do certain cells form a finger while others do not? Freiburg biologists have explained the mechanisms that control these steps by showing why veins form at particular points in the wing of a fruit fly. The protein Pentagone spreads a particular signal in the wing that tells the cells how to behave. "The proteins Dpp and Pentagone, which are crucial for this developmental step in the organism Drosophila melanogaster, are also present in a similar form in humans," says the Freiburg biologist Dr Giorgos Pyrowolakis. "The fundamental principles elucidated in this study are also active in humans, where they might control things like where cells form fingers." Pyrowolakis and a team including Jennifer Gawlik, Dr. Mark Norman, Alexander Springhorn, and Robin Vuilleumier published their findings in the journal *eLife*. In the future, the results could contribute to our understanding of the origin of developmental disorders.

The protein Dpp is located in a cellular field in various concentrations. The cells located in the middle of the future wing produce Dpp. The protein spreads to the rest of the cells in the tissue, becoming less concentrated in the process. In mathematical terms, this

phenomenon is referred to as a concentration gradient. A cell activates different genes depending on where it is located in the gradient. Each cell develops as specified by the genes activated in it, and veins develop when certain thresholds have been reached. Hence, the gradient determines the distance between the veins of the fruit fly wing.

The cells located furthest from the Dpp source produce Pentagone. Without this protein, there would be no concentration gradient in the cell network and Dpp would stuck at the point of its production. If the gene for Pentagone is switched off in fruit flies, the wings of the insects are smaller and the external vein is missing. "Pentagone causes Dpp to keep spreading," explains Pyrowolakis, "thus extending the distribution-range of the protein."

The Freiburg biologists elucidated the molecular mechanisms behind these processes in their study. Dpp binds to receptors located on the surface of the cell in the future wing and initiates a signal cascade in the cell. The signal cascade activates different genes depending on how many receptors are bound by Dpp. Pentagone binds to a particular part of the receptors, the so-called co-receptors. They function like tentacles, 'grabbing' proteins and passing them on to the receptor. Pentagone causes the co-receptors to be pushed into the cell to be broken down. This reduces the amount of co-receptors that can bind and pass on Dpp on the cell, causing the receptors to be less active. The concentration gradient of Pentagone is opposite than that of Dpp. The closer a cell is located to the point where Pentagone is produced, the less Dpp it can bind. The amount of Pentagone is adjusted to match that of Dpp. "When the wing grows, the Dpp gradient also expands," says Pyrowolakis. "Pentagone regulates the gradient in a similar way a thermostat adjusts the temperature."