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research*eu
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EDITORIAL

by the editorial team

HOW CAN SCIENCE HELP US FACE FUTURE SEISMIC HAZARDS?

Europe is certainly not the region of the world with the highest number of earthquakes or volcanic activity, especially when compared to Indonesia or Japan. Yet, two Member States — Italy and Greece — appear in the top 12 of the countries with the most seismic activity since 1900. Recently, in January, Rome and Florence were struck by four earthquakes, only months after the country witnessed its strongest seismic disaster which killed as many as 300 of its citizens.

Europe is also prey to volcanic eruptions. In December 2016, Italian supervolcano Campi Flegrei started to show signs of awakening, whilst the eruption of the Icelandic volcano Eyjafjallajökull in 2010, after 200 years of inactivity, resulted in the largest air traffic shutdown since World War II.

'In the face of such threats, it has become clear that the European scientific community cannot rest on its laurels.'

In the face of such threats, it has become clear that the European scientific community cannot rest on its laurels. The three main branches of seismic research — monitoring instruments for better predictions, technologies for more resistant infrastructure and solutions to better bounce back from disasters — raise hope that, when the next disaster strikes, our societies will be better equipped to face it.

Budget funds from both FP7 and Horizon 2020 have been or are currently being invested to make this possible. In this issue of the research*eu Results Magazine, we explore some of the most recent breakthroughs brought about by these research funding programmes.

The selected projects touch upon a wide spectrum of issues, from building enhancements to economic asset protection, increased scientific cooperation, technologies to help emergency response units, advanced monitoring techniques and better understanding of natural phenomena surrounding earthquakes.

This special feature is followed by 10 other sections focusing respectively on health, society, transport, environment, agriculture & forestry, industry, Information & communication technologies, space and fundamental research. The magazine closes with a list of upcoming events hosted by or involving EU-funded research projects.

We look forward to receiving your feedback. You can send questions or suggestions to: editorial@cordis.europa.eu

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Focus on
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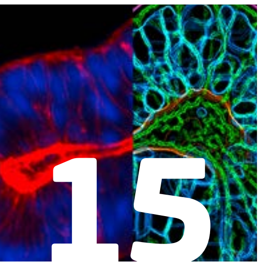
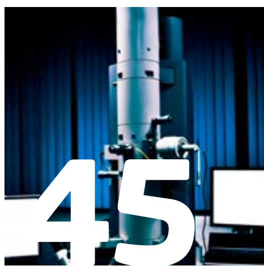




SPECIAL FEATURE

COPING WITH THE FORCES BENEATH THE EARTH'S CRUST

DIGGING HOLES AND BUILDING COLUMNS TO DEFEND AGAINST EARTHQUAKES

Although earthquakes and tsunamis are often unpredictable, there are defences that can be taken. For example, EU-funded researchers are protecting towns and villages by drilling holes in the ground.

In earthquake engineering, the amplification of seismic waves — namely site effects — can strengthen the impact of an earthquake in specific areas. This was seen in the 1985 Mexico City earthquake, which was particularly destructive and deadly because of the ancient lakebed that the city is built on. When seismic waves propagate through soft superficial alluvial layers — as was the case in Mexico City — or scatter on strong topographic irregularities, the phenomena of refraction and scattering can increase the amplitude of the ground in motion.

So what can be done to better protect these vulnerable areas? For researchers working within the EU-funded ANAMORPHISM (Asymptotic and Numerical Analysis of MOdels of Resonant Physics Involving Structured Materials) project, the answer is to dig a hole.

Holes and piers

ANAMORPHISM researchers have developed and tested a way to place boreholes at carefully spaced intervals in front of an area they want to protect, essentially creating a man-made barrier capable of deflecting an earthquake's shockwave. Tested in Grenoble, France, the project drilled three rows of 10 five metre deep holes. Generating a small 50 hertz surface earthquake, the ANAMORPHISM system successfully deflected the wave backwards.

'This experiment shows that, at much larger scales, natural soils civil engineered at decimetre to metre scales may interact with seismic waves when the global properties of the medium are modified,' says Project Coordinator Sébastien Guenneau.

The system can also be adapted to protect coastal areas against incoming tsunami waves by diverting them around villages rather than through them. Instead of using boreholes, however, the project builds a series of pillars on the waterbed. Just as the boreholes deflect a seismic wave, the pillars deflect the waves that approach them.

A seismic cloak

According to Guenneau, the ANAMORPHISM system is an adaptation of the invisibility cloak concept developed by British theoretical physicist John Pendry. 'Whereas invisibility cloaks deflect light waves around a hidden object, ANAMORPHISM's technology deflects the shockwaves from earthquakes and tsunamis,' he says. 'We're really applying the same tools to a different concept.'

However, Guenneau notes that before seismic cloaks can be used to protect buildings from earthquakes, further in-depth analysis is needed to achieve the required arrangement of boreholes. He notes that related theoretical research suggests replacing the boreholes with meta-cylinders with side holes, which would dampen the seismic surface waves and reduce the amount of seismic energy reflected from the metamaterial. 'The dampening of the seismic waves means that some of the energy carried by them is transformed into another type of energy, such as sound or heat,' says Guenneau.

Although further research and experiments are needed, Guenneau remains confident that, over time, the ANAMORPHISM concept can be scaled up and used to protect harbours and cities. In fact, the project has already given rise to two patents for seismic defence structures and a patent for a new generation of dykes to protect coastlines against tsunamis. 'Once scaled up, this technique could save hundreds of thousands of lives,' says Guenneau. 'Imagine a city of the future, fortified against seismic surface waves by a trench of bore holes or columns of concrete.'

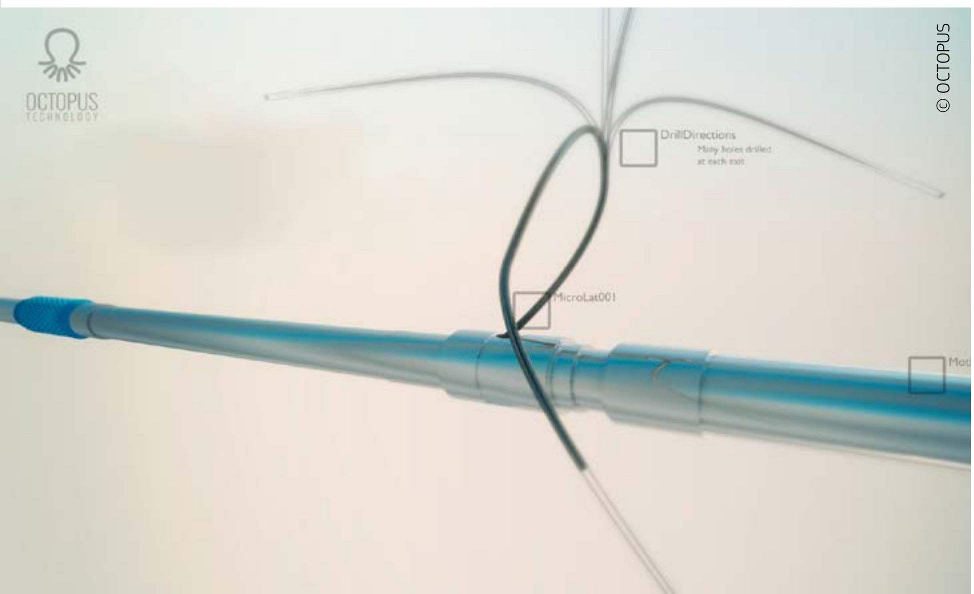
ANAMORPHISM

★ Hosted by CNRS in France.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/100361

INTERVIEW

A GREEN, EFFICIENT ALTERNATIVE TO FRACKING THAT CAN PREVENT EARTHQUAKES

Whilst the extraction of shale gas in a safe and responsible way is an EU priority, an extraction method easing public concerns has yet to found. Hydraulic fracturing — commonly known as 'fracking' — not only fails to fit the bill, it is also known to trigger earthquakes. A UK-based company is putting forward a promising alternative in the EU-funded OCTOPUS TECHNOLOGY project.



© OCTOPUS

Octopus Completions strongly believes in its technology, which they think 'will lead to the development of an economical, fast and environmentally sustainable alternative to fracking technologies.' And, as a matter of fact, a technology even superior to fracking's so-called 'green', waterless counterpart.

Octopus is a drilling technology that creates hundreds of 'micro laterals' simultaneously, all emerging from a vertical or horizontal well bore. The technique leaves the mother bore with full bore access for the future, increases productivity by 2 to 10 times compared to state-of-the-art techniques, and enables well completion 40 to 80 days earlier than with existing multi-lateral well-completion technologies.

With support from the SME Instrument, the company is now looking to further develop the technology and demonstrate its efficiency and environmental performance to potential clients. This certainly seems worthwhile: fracking is currently used in 160 000 wells across the world. The promise of a technique that boosts productivity, avoids the pollution of billions of litres of clean water and reduces the risk of earthquakes arising from the injection of this polluted water into the ground has the potential to shake up the sector.

Nick Barnett from Octopus Completions discusses this potential, the results from the Phase 1 feasibility study and the commercialisation plans ahead.

★ How is your technology superior to alternatives?

Nick Barnett: Octopus simultaneously drills hundreds of micro laterals, eliminating time wasted on repeated tool changes and trips in and out of the well. After completion, the main well (motherbore) is left uncluttered, allowing easy access for future interventions. There's no use of additional water or materials, which eliminates almost all the load on local roads and the risk of earth tremors. It also does away with the spectre of pollution — and further stress on road networks — when the foul water has to be 're-situated' after fracking.

★ What's your opinion on efforts to develop 'green' fracking instead?

Waterless fracking has been going on since 2009 and is technologically a very commendable method of stimulating wells. It is still regarded as unproven though, some 8 years after its introduction and has not yet gained significant traction.

It's also seen as a costly option, even though the LPG used (propane or butane) can be re-sold after stimulation.

★ Can you explain how Octopus technology works?

Since many of the details of Octopus are commercially sensitive, this is a very superficial description: Octopus joints are deployed into the well and then normal drilling fluid is used to pressurise the whole system to typical drilling conditions.

This results in micro laterals simultaneously drilling their way out from the motherbore and forming supported 'tributaries'. Drilling takes only a short while to complete, after which the well is de-pressurised and starts producing. Industry standard models show that yield can be increased by more than three times that of a conventional well.

★ How did you proceed to enhance this technology?

As with most of our technical developments, we have adopted a process of incremental scaling up. We tested individual element functionality before combining these elements in a workshop environment for initial systems tests, finally integrating them to form a basic operational system for field trials in the future.

★ How have potential customers reacted to your work so far?

We have been receiving letters of interest and support from a number of potential customers and, although it is still a little early to be choosing our commercial partner, we are interested in pursuing these early, positive reactions with a view to developing more substantial relationships going forward.

★ What were the main learnings from your feasibility study?

We now understand better where our early potential markets lie, geographically and by formation/operation type. We have also gained interest in the potential of our technology for the renewables sector.

★ Are you applying for Phase 2 funding? If so, what will you try to accomplish with this additional support?

We are already building the Phase 2 proposal and believe that this will fast-track our company efficiently and rapidly to the level where we will be able to develop a global presence.

OCTOPUS TECHNOLOGY
★ Coordinated by Octopus Completions in the United Kingdom.
★ Funded under H2020-SMEINST.
★ http://cordis.europa.eu/project/rcn/206797

NICK BARNETT

"We have been receiving letters of interest and support from a number of potential customers."

INTERNATIONAL COLLABORATION OVER GEOHAZARDS

An EU-funded initiative exchanged leading European researchers with India and China to further knowledge and understanding of geohazards.

The aim of the GEO (Geohazards and geomechanics) project was to bring together world class research groups engaged in assessing, preventing and mitigating geohazards. Floods, landslides and earthquakes were mainly studied, as well as the effect of climate change and human activity on soil degradation.

Project partners sought to improve understanding of why flood defences failed and also to improve models of areas prone to flooding. They investigated the geomechanical conditions leading to the onset of landslides, modelling debris flows and mud flows to estimate the destructive power of the landslide materials.

A unified bond contact model based on micro-mechanical test data was developed for determining rock slope instability. The model was implemented using a 'Distinct element method' (DEM) code to analyse the time-dependent behaviour of weathered rocks and jointed rock failure due to weathering.

The code was used to conduct numerical simulations, including compression and tension tests. The validated model was then used to simulate crack propagation and rock fracture and then compared with experimental observations. The role of internal shearing in compound landslides was also studied using 'Material point method' (MPM) to simulate landslides.

Researchers also developed a quantitative mapping method for determining the lateral spread hazard associated with earthquake induced liquefaction and considered all possible earthquakes occurring at a site. The effectiveness of the models and procedure was demonstrated through the use of case studies.

New numerical tools were developed for analysing potential failures and submarine landslides triggered by the exploitation of 'Methane hydrate bearing sediments' (MHBS) in deep water seabeds. In addition, a new thermal-hydro-mechanical coupled bond contact model of MHBS was created based on micromechanical tests.

GEO not only brought together world class scientists, it also trained early stage researchers. As such, it improved the current standards and codes ruling geohazards and generated new approaches to resolving research challenges.

GEO
★ Coordinated by the University of Warwick in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/102415

TECHNOLOGIES TO BETTER BOUNCE BACK FROM NATURAL DISASTERS

So far, decision-makers tasked with making their region better prepared for natural disasters have been focusing on improving infrastructures to increase their resistance. But in the face of lukewarm results, the IRUSAT project is proposing to focus on the speed of post-disaster recovery. They developed a virtual city model and a wristband device to enable better emergency response.

Natural disasters are on the rise. From earthquakes to flooding, volcanic eruptions, hurricanes or wildfires, these events have become the most tangible realisation of climate change, and the world has so far failed to approach this challenge in any other way than paying the damage bill. From 1991 to 2010, more than five times as much was spent on disaster response as on disaster risk reduction, according to UN figures.

The consequences of this lack of planning are often tragic: In 2005, Hurricane Katrina struck the Gulf Coast region in the United States. It caused breaches in the flood protection system in New Orleans, resulting in substantial structural damage to residences in the immediate vicinity of these breaches. Approximately three quarters of the city was flooded. Bridges were damaged by the uplift, and industrial facilities such as seaports and petrochemical facilities also took a considerable hit.

'The unprecedented state of emergency brought about by Katrina renewed focus on the need to address protection from the threat of natural disasters, in addition to man-made hazards,' says Prof. Gian Paolo Cimellaro, associate professor at the Department of Structural, Geotechnical & Building Engineering of the Polytechnic University of Turin, and coordinator of IRUSAT (Improving Resilience of Urban Societies through Advanced Technologies). More specifically, the scientific community started to investigate the concept of resilience.

'Several mitigation strategies already exist to improve the performance of infrastructures. These can be based, for example, on innovative technologies such as base isolation for bridges combined with the use of passive systems such as viscous dampers, hysteretic dampers, etc.,' Prof. Cimellaro continues. 'But while these methodologies are all able to reduce the physical damage caused by natural disasters, recent events have shown that most often physical damage cannot be avoided. This is where resilience — that is, the ability to bounce back from crisis — is required.'

Predicting the financial impact of disasters

Finding an appropriate resilience strategy is not an easy task. As our societies rely on increasingly interdependent systems, resilience strategies need to first consider the risk of a domino effect. For each local or regional community, weak points of the economic system should be identified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and protected so as to enhance economic resiliency in case of natural disasters. IRUSAT proposes a model to achieve just that, as Prof. Cimellaro explains.

'Our model, which was applied to the San Francisco Bay Area, describes the economic effects and characteristics that should be taken into account to predict the monetary impact of natural disasters, focusing in particular on the economic interdependencies of industries and lifelines.'

The model uses multiple sources: real economic data provided by surveys on specific natural disasters, data on physical damage contained in the HAZUS database, and the Economic Resilience Index provided in the PEOPLES framework. A sensitivity analysis is performed for each economic sector considered in the analysis, and a final global economic resilience index is obtained. One of the main outcomes of the model resides in so-called 'autonomy curves': 'We derived these from the probabilities of business closure obtained thanks to business surveys and simulations focused on our case study area,' Prof. Cimellaro points out.

Thanks to this work, the team is now able to propose IDEALCITY, a virtual city model that simulates all the main infrastructure interdependencies during a crisis caused by an extreme event. This is expected to help decision-makers to define strategies for reinforcing local and regional systems.

'The focus should shift towards restoration strategies, trying to improve the speed of recovery and reduce the downtime of the infrastructures. This will be possible not only by focusing on reducing the structural and non-structural damage, but also by improving emergency responses from the likes of firefighters, police or civil protection.

Technologies to better deal with emergencies

A key contribution of IRUSAT in this regard consists of a wristband device and a customised 'Structural health monitoring' (SHM) system for managing emergencies. Fully independent from external power and communication networks, the system allows for indoor geolocation. This can be very useful for, say, firefighters entering buildings on fire and who might otherwise lose their sense of direction.

'We are planning to test the technology on people wearing the device and positioned on a shaking table, in order to test the capacity of the device to collect and transfer the information through a radio frequency system during the shaking,' Prof. Cimellaro explains. 'Large-scale simulations are also planned to test the capacity of the system in a large-scale environment with a large number of users, and we will ask real firefighters from the Piedmont Region in Italy to participate.'

Besides the commercialisation of this device, the team hopes to be able to create a virtual city where rescue teams can monitor and improve their performance. 'In the long term this tool will be used by decision-makers in real time, to verify the effect of their decisions during an emergency in a complex system such as a community,' Prof. Cimellaro concludes.

IRUSAT
★ Coordinated by the Polytechnic University of Turin in Italy.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/108725

INTERVIEW

DEFORMABLE CONCRETE FOR EARTHQUAKE-PROOF BUILDINGS

When creating structures capable of withstanding earthquakes, engineers currently rely on force-based methods only. They cannot decide how the structure will adapt to seismic vibrations, which can in turn lead to undesirable failures. An innovative design for a highly deformable reinforced concrete structure is hoped to bring such freedom, whilst optimising the use of resources, minimising costs and ensuring safety.

DR DAVID ESCOLANO

The SHDS (Seismic-resistant Highly Deformable Structures) project builds upon the results of another EU-funded project called ANAGENNISI, which is recycling tyre rubber particles into replacements for both fine and coarse concrete aggregates.

By using this 'High deformability concrete' (HDC) in flexible coupling beams and developing ductile shear walls, the team aims to develop a structure with controlled performance where structural damage is concentrated on specific, dedicated elements. This means easier and faster repairs, whilst contributing to a circular economy.

Dr David Escolano, Marie Curie individual fellow at the University of Sheffield and coordinator of SHDS, discusses the project's ambitious achievements so far.

★ The project considers structure performance rather than its strength. How is it important?

Dr David Escolano: Under force-based methods, seismic action is defined using lateral 'equivalent forces' distributed over the structure's height. The elastic magnitude of such forces depends on the hazard level at the site (ground accelerations), and, for sites with high seismic hazard, existing codes allow for reducing the lateral forces. This results in more cost-effective structures, provided of course that these structures can endure a certain amount of damage before collapse.

Whilst such design philosophy is straightforward, easy to use and effective at avoiding potential loss of life, engineers are moving towards a design philosophy that would allow them to design structures that can resist earthquakes of different severity within specified limiting levels of damage, that is, a 'Performance-based design' (PBD). Such design would enable the development of optimal structures, maximise use of resources and minimise costs, all this while yielding acceptable levels of safety and empowering designers to experiment with new design solutions, innovative materials and structural components so as to achieve the desired performance levels.

★ What does SHDS bring to the table in this regard?

The SHDS project focuses on a very specific structural component: coupling beams in coupled wall systems. Two or more structural walls are linked through beams according to a regular pattern over the height of the structure, which improves the seismic performance of each individual wall and provides a very stable source of energy dissipation.

As the overall behaviour of the system depends heavily on the deformation capacity of the coupling beams, our goal is to develop innovative solutions for the construction of coupling beams with unparalleled deformation capacity thanks to the use of a newly developed HDC.

★ What is HDC and what's its added value for this project?

HDC is a product of the ANAGENNISI project which aims at finding ways of using all components of post-consumer tyres in high-value concrete applications. One of its focuses consists in replacing the mineral aggregates in concrete with rubber particles so as to increase the deformation capacity of traditionally brittle concrete.

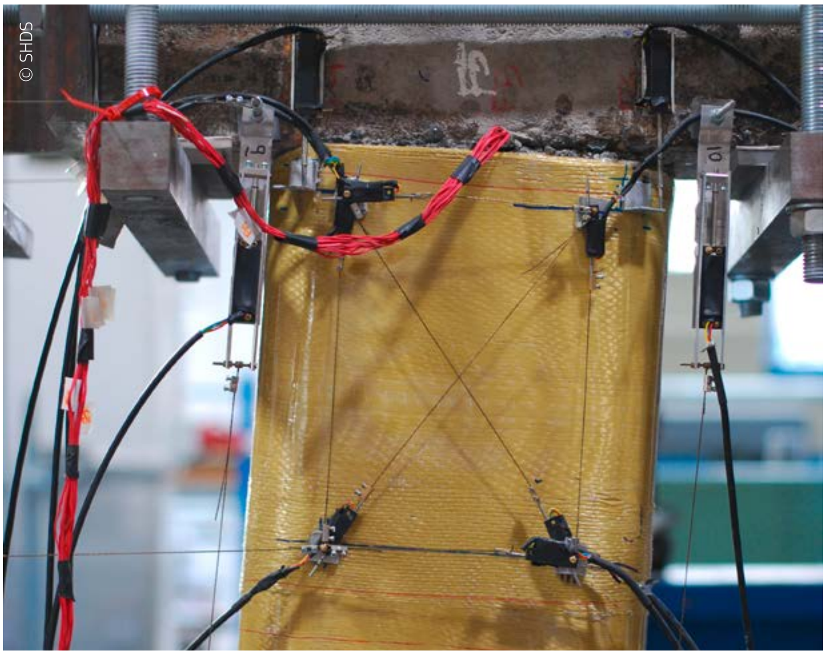
As high deformability requires high rubber content, which in turn can drastically reduce the material's compressive strength by up to 90%, HDC also uses advanced composite jackets to enhance the compressive strength to structural grade while keeping the desired large axial deformation capacity of rubberised concrete. A mere 1.6 mm thick Aramid jacket wrapped around rubberised concrete columns can lead to extraordinary strength and deformability enhancements.

★ Two of your main arguments in favour of this new concrete are its sustainability and ease of repair. Can you elaborate on these?

PBD allows engineers to design predetermined and well-engineered components that can attract damage during earthquakes. As a result, post-earthquake repairs in PBD-designed structures would focus on these components rather than on the whole structure. The coupling beams being developed in this project work as 'fuses' and are the first elements to sustain considerable damage during an earthquake, in turn protecting the majority of the remaining structural and non-structural components.

As for sustainability, the proposed coupling beams can be easily replaced after major seismic events, thus minimising costly repairs, and limiting the impact on the community by enabling a much faster occupancy. The proposed coupling beams also use materials recovered from waste tyres, thus assisting in achieving a greener economy with reduced waste production and pressure on raw materials.

"HDC coupling beams can resist similar loads to their traditional counterparts while exhibiting four times more deformation capacity."



★ What can you tell us about the results of the testing phase so far?

At the material level, we have tested more than 300 cylinders/cubes to analyse the fresh and hardened properties of rubberised concrete. Different mixes and rubber quantities were tested, which ultimately resulted in the development of an optimised mix with 60% rubber replacement of the coarse and fine mineral aggregates. This optimised mix was adopted for the final development of HDC.

Different types of advanced composite jackets were then trialled to provide the optimal combination of deformation capacity and strength, including Aramid and Carbon FRP. The developed HDC can achieve compressive strengths suitable for structural purposes (40-120 MPa) with maximum axial deformations 20 times larger than possible with traditional concrete.

The results of SHDS so far are very encouraging and show that HDC coupling beams can resist similar loads to their traditional counterparts while exhibiting four times more deformation capacity.

★ Have you been in touch with potential investors so far?

We have not contacted any possible investors yet. For structural applications, we believe we are in a Technology Readiness Level of 5 and therefore we are not ready for commercialisation. We are still developing the technology and we need to further our understanding of the material and its structural performance before we are ready to move to the next level. We are also performing tests to assess the long-term durability of the new HDC.

Another important issue to keep in mind is that our new material and engineering solutions are not covered by any of the existing standards and more work needs to be done in this direction to allow adoption and use of such novel technologies. However, we are very excited about what we have seen so far and we hope that the construction industry will see the value of the several innovations we are proposing.

★ What are your plans after the end of the project?

The work on SHDS has led to some very positive outcomes, but has also raised a number of very interesting questions on both the physical and structural behaviour of HDC, and its many possible uses in structural applications. If given the opportunity, we would like to further develop our understanding of this material and examine its long-term performance (including creep and fatigue) and response to the likes of fire and impact.

SHDS
★ Coordinated by the University of Sheffield in the United Kingdom.
★ Funded under H2020-MSCA.
★ http://cordis.europa.eu/project/rcn/195573

SPECIAL FEATURE

SMART OBSERVATION FROM GROUND AND SPACE PROVIDES PROTECTION FROM EARTHQUAKES AND ERUPTIONS

By combining ground and space based sensor data, the EU-funded APHORISM project has developed tools to reduce risk and improve emergency management, in response to seismic and volcanic events.

As is all too often evidenced, effective emergency response relies on accurate and timely information. With data coming from a variety of observational sources, such as satellite and ground sensors, a key challenge is being able interpret this raw data to make it meaningful for effective mitigation or emergency response efforts.

The APHORISM (Advanced PRocedures for volcanIc and Seismic Monitoring) project focussed on improving data for seismic and volcanic crisis management, developing two new methods that combined Earth Observation satellite data from different sensors, with that of ground data. As Dr Merucci, one of the project leaders, points out, 'These provide more accurate damage mapping products which are extremely useful to mitigate the effects on population and infrastructures.'

Improving damage assessment for earthquakes and eruptions

When it comes to seismic events, analysing satellite data to ascertain the scale of damage, is not in itself innovative. However, APHORISM's innovation with their 'A Priori information for Earthquake' damage mapping (APE) methodology, was to integrate change detection maps, with situational information from before the event. This a priori data was derived from 'Interferometric synthetic aperture radar' (InSAR) which monitors and measures surface movements, shakemaps derived from seismological data, and vulnerability assessments. As Dr Merucci recaps, 'The main step forward was the adoption of novel damage indicators, able to exploit the vulnerability of urban settlements, such as data about structural vulnerability of buildings, completely independent from Earth observation data.'

The second key objective of APHORISM was to develop a system for improved volcanic crisis management. Volcanic eruptions through their emission of gas and solid particles are one of the major natural polluters, often resulting in significant social, economic and environmental impacts. To enhance ash detection, APHORISM developed the 'Multi-platform volcanic Ash Cloud Estimation' (MACE) procedure. As Dr Merucci explains, 'The novelty of the MACE approach is that the geostationary instrument sets the pace and the spatial resolution of the ash cloud detection and retrieval. This knowledge is then improved by using additional datasets.'

These datasets included the regular and frequent data acquisition of the SEVIRI sensor on board the 'Geosynchronous Earth Orbit' (GEO) 'Meteosat Second Generation' (MSG) satellite, with the less frequent but higher sensitivity of 'Low Earth Orbit' (LEO) sensors, along with *in situ* ground data which is of very high spatial resolution and acquisition frequency, but on a limited area. Additionally, the usual thermal infrared ash retrieval was combined with wider spectral data ranging from visible to microwave and detection was extended to cater for cloudy and steamy conditions.

From sensors to Sentinels

After being validated against recent relevant historical events, APHORISM's prime concern was to transform the procedures into deployable products. APE has resulted in the 'Likelihood Index Damage Map' (LIDaM), using very high resolution imagery at the scale of single buildings, and with medium resolution satellite data at the level of groups of buildings. According to Dr Merucci LIDaM will, 'ensure a prompt response to aid rescue teams, identifying the most damaged areas where to concentrate rescue activity as well as reduce false alarms.' In the case of ash detection, 'Integrated Ash Products' (IAPs) have been created, including those which generate mass, effective radius, aerosol optical depth, concentration, and cloud height maps, improving air traffic security.

'These APHORISM products can enrich the portfolio of Emergency Mapping Services, especially as part of the European Space Agency's (ESA) Sentinel satellite missions designed to deliver the Copernicus programme,' summarised Dr Merucci. Copernicus is the world's largest global monitoring programme, set up to provide environmental management information for marine, land, atmosphere, emergency, security and climate based decision making.

APHORISM
- Coordinated by INGV in Italy.
- Funded under FP7-SPACE.
- http://cordis.europa.eu/project/rcn/188813
- Project website: http://www.aphorism-project.eu/

INTERVIEW

A NOVEL VOLCANIC GAS OBSERVATION TECHNOLOGY TO IMPROVE ERUPTION PREDICTION MODELS

Current volcano monitoring techniques essentially revolve around geophysical observations. Building upon the consensus that volcanic gases are another determining factor in volcanic eruptions — one that cannot be ignored — the BRIDGE project has set out to develop gas monitoring technologies whose combination with geophysics should help improve predictions.

Funded under an ERC grant, the BRIDGE (Bridging the gap between Gas Emissions and geophysical observations at active volcanoes) project aims at no less than 'prompting a major scientific and technical advance in volcanology.' It was built upon the observation that, in spite of recent technological progress, volcanic gas observations' contribution to volcano monitoring is still very limited.

This result in an inability to make real-time high-rate observations of volcanic gas flux and compositions: To this day, geochemists have been experiencing technical difficulties in capturing volcanic gas chemistry and flux at a high rate (1 Hz) and using permanent instrumental arrays. Moreover, the poor temporal resolution of existing observations has made it impossible to analyse fast-occurring volcanic processes such as those occurring shortly prior to eruptions.

BRIDGE technology is solving these problems with innovative instruments for 1 Hz observations of volcanic SO_2 and CO_2 fluxes. Information gathered from these instruments can be combined with geophysical data in order to fill in current knowledge gaps and yield improved modelling of a variety of volcanic features, including mechanisms triggering explosive volcanic eruptions.

★ How do you explain the fact that volcanic gas observations lag so far behind?

Prof. Alessandro Aiuppa: Volcanic gases are a relatively recent topic of study. While more established geophysical techniques have been used on volcanoes for more than a century — for example, seismicity which has been monitored since the mid/late 1800s — volcanic gases attracted scientific investigation only in the 1930-50s. Instrumental volcanic gas observations only started in the 1970s and were consolidated only in the 2000s.

This 'late' interest of scientists in volcanic gases explains the gap it leaves in geophysics.

★ What are the consequences for the accuracy and effectiveness of volcanic observations?

Although a deterministic forecast of volcanic eruption onset is still challenging, volcanologists now have a much clearer understanding of the processes that drive a volcano to erupt, and it is clear that magmatic volatiles play a key role. They are transferred from the silicate melt into a magmatic gas phase as the magma is decompressed on its way to the surface; and formation and expansion of this exsolved gas phase leads to magmatic pressure build-up that triggers an eruption. It is therefore vital to study their composition and flux.

Unfortunately, direct sampling of volcanic exhalations and analysis in the lab have so far hampered the analysis of fast-occurring volcanic processes, and have limited refinement and/or experimental validation of models of magma flow (and degassing) shortly before eruption.

★ How did you aim to solve this problem?

Our goal was to refine existing techniques and set up new technologies for studying volcanic gases. We designed, produced, tested and field-deployed a new generation of volcanic gas sensing instruments, and we successfully realised the first prototypes of fully automated UV camera networks. This is affording us long-term continuous volcanic SO_2 flux observations at high temporal resolution (> 1 Hz, and up to 25 Hz) with a compact, robust and easy-to-use configuration.

We have also refined a novel technology called 'Multi-component Gas Analyser System' (Multi-GAS), a gas sensing unit that has become the reference for *in situ* nearly continuous monitoring of volcanic gas plume composition. Finally, we have also fully succeeded in the challenging task of developing the first DIAL-Lidar for direct, remote sending of the volcanic CO_2 flux.

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PROF. ALESSANDRO AIUPPA

Our multi-instrument, ready-to-deploy gas sensing network enables fast responses for future volcanic crises in the EU or elsewhere. The instrumental gas monitoring devices, realised within BRIDGE, are now being exported to several volcano observatories worldwide, where they are being implemented in local monitoring networks.

★ Can you explain how these instruments work?

OUV cameras are CCD devices that are used to take sequences of images of a volcanic plume (the atmospheric dispersion of volcanic gases). Images are captured using optical filters, allowing us to show limited portions of the incoming solar radiation. By simultaneously exposing two cameras, selective absorption of incoming sunlight by volcanic SO_2 can be quantified and converted into an SO_2 flux (mass of SO_2 released per unit of time by the target volcano).

Our multi-GAS instruments, then, are compact multi-sensor units combining infra-red spectrometers and electrochemical sensors. Volcanic gases/plumes are actively pumped inside the Multi-GAS, and the concentrations of different gases (H_2O, CO_2, SO_2, H_2S, H_2, HCl) are measured in real time (at 1 Hz). The Multi-GAS is permanently deployed on a volcano's summit with data being telemetered to a volcano observatory. Accurate temporal records of volcanic gas compositions are therefore obtained.

Finally, the DIAL-Lidar is essentially composed of a transmitter (laser) and the receiver (telescope). A lidar is merely an optical radar: a laser pulse is transmitted to the atmosphere, and some of its photons are backscattered to the telescope by air molecules and aerosols. The optical power corresponding to this photon flux (transformed into an electronic signal by a photodetector) is proportional to the chemico-physical properties of the atmosphere along the laser beam. Air attenuates the laser pulse due to molecules and aerosol scattering and to the specific absorption of gases: if the laser wavelength coincides with absorption lines of a target gas, the attenuation will be stronger.

DIAL takes advantage of this effect: unlike a usual lidar, two wavelengths, ON and OFF, are transmitted, with only the former being absorbed by the target gas. If the absorption line is narrow and ON and OFF wavelengths are close enough, the target gas concentration along the lidar optical path can be derived from the ratio between the OFF and ON signals. In our specific case, we developed a novel dye-laser-based DIAL-Lidar using a complex transmitter that integrates an injection seeded Nd:YAG laser with a double grating dye laser. This transmitter is used to generate laser radiation at ~2010 nm, a region of the electromagnetic spectrum absorbed by atmospheric CO_2.

★ Are you happy with the results of your field tests?

Very happy. All the instruments developed have successfully been installed at active volcanoes and are now contributing a huge flow of data, providing key information on volcano behaviour. Our project has successfully completed a novel interpretative scheme of shallow crustal volcanic processes, based upon the combined analysis of co-acquired volcanic gas and geophysical (seismic, infrasonic, geodetic, thermal) signals.

★ What would you say are the most important learnings from the project?

The key lesson from BRIDGE is that understanding volcano behaviour requires a multi-disciplinary angle of attack. Achievements in BRIDGE make the case emblematic, and demonstrate that integration of volcanic gas and geophysical data is key to improved understanding of mechanisms of gas/magma ascent within magmatic conduits during quiescence, and prior to/during volcanic eruptions.

Our multi-disciplinary monitoring observations at the Stromboli and Etna volcanoes, made possible thanks to the observational networks realised in BRIDGE, reveal that more accurate eruption forecasting is possible when gas and geophysical signals are jointly analysed.

"Our multi-instrument, ready-to-deploy gas sensing network enables fast responses for future volcanic crises in the EU or elsewhere."

BRIDGE
- ★ Hosted by the University of Palermo in Italy.
- ★ Funded under FP7-IDEAS-ERC.
- ★ http://cordis.europa.eu/project/rcn/105362
- ★ Project website: http://www.bridge.unipa.it

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HOW DO UNANCHORED LIQUID STORAGE TANKS PERFORM IN THE EVENT OF EARTHQUAKES?

Seismic resistance requirements for anchored liquid storage tanks are clearly defined in dedicated design provisions. But are these provisions applicable to their unanchored counterparts? Researchers funded under the LIFTING TANKS project developed mathematical models in order to find out.

Being essential components of lifeline and industrial systems, liquid storage tanks need to be kept safe. But the harsh truth is that they aren't: earthquake-caused failures have often resulted in spillage of toxic materials over the years, sometimes leading to disastrous effects.

One of the most notable examples was the Izmir earthquake in 1999. Liquid storage tanks at the Tupras refinery were destroyed by fires and burned out of control for several days. Approximately 30 of the 45 tanks in the refinery were severely damaged, and some of the oil spilled into Izmit Bay. As liquid storage tanks usually contain oil, chemicals, liquid fertilisers or food processing products, this is just an example of how damage to these tanks and the resulting liquid leaks can cause severe social, economic and environmental problems.

'When such tanks are located in earthquake prone regions, they should be designed to survive earthquake effects and remain functional even after they are over,' says Dr Bülent Erkmen, assistant professor at Özyeğin University and coordinator of the LIFTING TANKS (Seismic Analysis of Liquid-Storage Tanks with a Focus on Tank-Base Uplift) project.

"Our findings suggest that tank maximum base shear and moment computed using current seismic provisions may not be sufficient for unanchored tanks."

There are two existing types of liquid storage tanks: anchored and unanchored. The former, whose seismic behaviour is well established under seismic design codes such as API-650 and Eurocode 8, requires a substantial foundation and attachment mechanism in the form of bolts to withstand the considerable force of seismic loads.

Facing the limitations of design standards

Unanchored tanks, however, are a different story. They are particularly subject to damage during earthquakes, yet are more widely used because they are less expensive.

'Studies on the seismic performance of unanchored tanks and the effect of tank base uplift on this performance are very limited,' Dr Erkmen says. 'Most of the theoretical and computational studies on unanchored tanks do not include the effect of sloshing water breaking, vertical seismic loads, and effects of tank base uplift on hydrodynamic loads.'

In other words, the seismic response of unanchored tanks during earthquakes, which was at the heart of LIFTING TANKS research, is still very much unknown.

The main objective of LIFTING TANKS was to lift the veil on this response, as well as to evaluate the applicability of current seismic provisions for unanchored tanks. Detailed 3D tank

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'finite element' (FE) models considering liquid-structure interaction were developed and verified, before being used to investigate the seismic performance of various liquid-storage tanks based on a large number of earthquake records using time-history analysis. These models take into account earthquake characteristics, tank geometry, liquid content level and tank site soil properties.

'For example, our experimental studies and observations have demonstrated that the radial length of uplifted bottom plate and base-uplift, and hence, the actual liquid weight resistance which is mobilised during an earthquake, is substantially underestimated by API-650 provisions for unanchored tanks. API-650 provisions also predict an unrealistically narrow compression zone at the toe of the tank, thus leading to large compressive stresses in the tank shell,' Dr Erkmen notes.

Room for improvement

Overall, project results indicate that the traditional mechanical spring-mass analogy model, which serves as a basis for current seismic design provisions like API-650 and Eurocode 8, cannot be used to predict unanchored tank base uplift and its effects on tank seismic performance.

'Moreover, our findings suggest that tank maximum base shear and moment computed using current seismic provisions may not be sufficient for unanchored tanks. Seismic provisions should be more conservative, seismic design provisions should be updated, and more research should be conducted,' Dr Erkmen argues.

As the project only foresaw two years of research, it could not include any experimental work and instead focused on computational mathematical models to predict tank seismic behaviour. However, the team is conscious of the need for experimental studies to validate these mathematical models.

'We are very interested in pursuing this research,' Dr Erkmen explains. 'Seismic performance of a scaled liquid-storage tank will be tested using a shake table and recorded earthquake data at the host institute. The water sloshing during earthquake loading will be recorded using high-speed cameras, and the experimental data will be used to further validate our mathematical models. Overall, our future efforts will focus on the effects of tank base uplift on tank base shear force, overturning moment, overall stability and tank shell buckling, tank water sloshing, and free board requirements.'

LIFTING TANKS
★ Coordinated by Özyeğin University in Turkey.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/186275

INFLUENCE OF SILT ON SOIL LIQUEFACTION

Research engineers have investigated the role played by tiny grains of sand like particles (known as silt) in the liquefaction of soils following earthquakes. This phenomenon can result in serious loss of life and significant damage to buildings and infrastructure.

Soil liquefaction refers to the process whereby the strength and stiffness of a soil is reduced by an earthquake or other sudden change in stress. By undermining the foundations of buildings and other forms of infrastructure, liquefaction can cause enormous damage — as witnessed in the 2011 Christchurch earthquake in New Zealand, for example.

The aim of the EU-funded project LIQUEFCTN SILTYSANDS (Influence of silt characteristics on liquefaction behaviour of silty sands) was to investigate the effect that silt-size soil grains have on the liquefaction behaviour of sandy soils.

This is an important area of research because of cases throughout the world of liquefaction involving silty sands following earthquakes. However, liquefaction can also occur under static loading conditions such as those found in mine tailings, spoil heaps, embankments, levees and earth dams, where sand and silty sand exist.

LIQUEFCTN SILTYSANDS had three main objectives, the first being to investigate the effect of silt on liquefaction of silty sands under static loading conditions. The second objective was to investigate the effect of silt grains on liquefaction behaviour of silty sands under dynamic loading conditions, such as seismic loading during earthquakes.

These first two objectives were investigated using monotonic and cyclic compression tests on different silty sands. The final objective was to draw up recommendations for geotechnical engineering research and practitioners involved in the evaluation of liquefaction.

Initial results revealed that the availability of silt-size grains (smaller than 0.0075 mm) in sand increases its liquefaction potential. Furthermore, the liquefaction potential was increased by a range of factors, including the size and gradation of the silt fraction within the dominating sand matrix.

Researchers also discovered that variations in shape characteristics, such as angularity, of the silt grain matrix in sandy soils could also influence their liquefaction behaviour. It was also found that there was a coupled relationship between various silt characteristics like fines content, shape and gradation, and liquefaction.

Results from LIQUEFCTN SILTYSANDS will clarify which factors increase, decrease or otherwise influence the liquefaction potential of sands. They will also show which kinds of corrections and modifications are required for current evaluation procedures, thereby helping to protect citizens from the effects of earthquakes.


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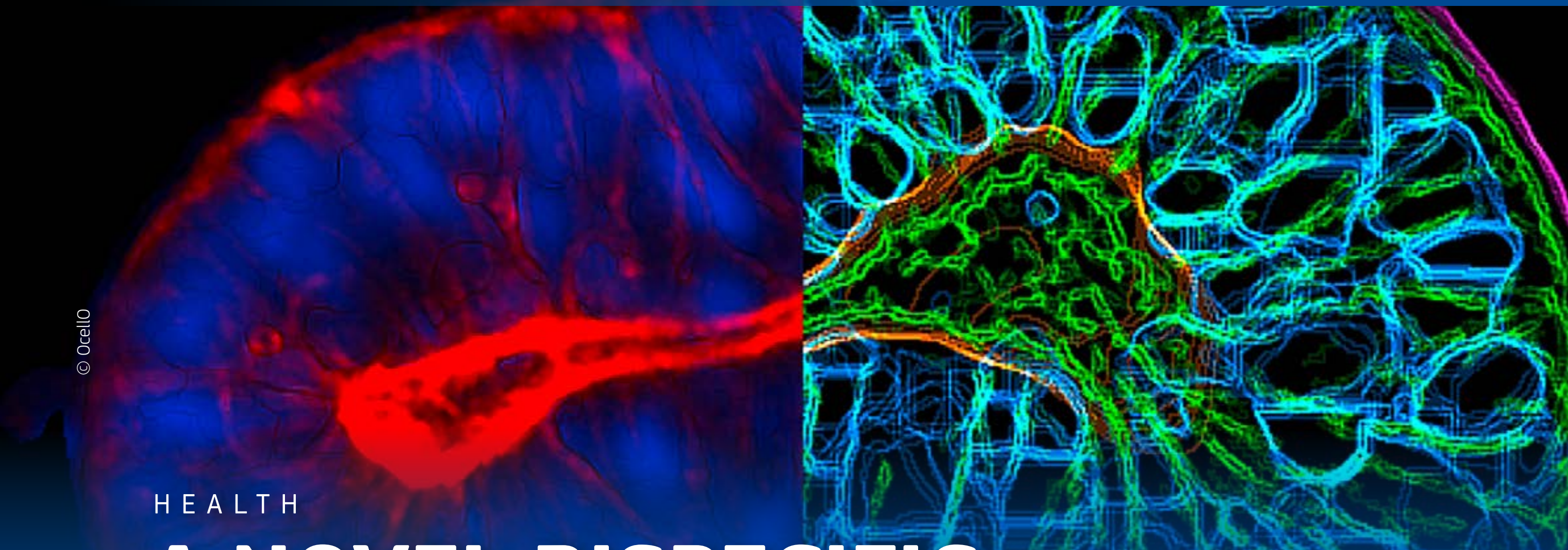
LIQUEFCTN SILTYSANDS
★ Coordinated by Yeditepe University in Turkey.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/102979

"Initial results revealed that the availability of silt-size grains (smaller than 0.0075 mm) in sand increases its liquefaction potential."



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HEALTH

A NOVEL BISPECIFIC ANTIBODY THERAPY AGAINST COLORECTAL CANCER

‘Colorectal cancer’ (CRC) is one of the leading causes of cancer-related deaths in Europe. A new antibody-based therapy developed using novel patient-derived screening technology, promises to specifically treat CRC patients with reduced side-effects.

Traditionally, most cancer drugs have been based on agents that block essential functions and kill dividing cells often resulting in harmful side-effects that diminish patient quality of life. Recent drug development has focused on targeted therapies that have less toxicity.

Among these, antibody-based therapy for cancer has become an established strategy for treating patients with different kinds of tumours. Human antibodies engineered to bind specifically to molecular targets present on the surface of cancer cells are indistinguishable from the natural antibodies the body makes to fight viral and bacterial infections. They retain the Y-shape of natural antibodies, and the variable antigen-binding region of the molecule has been designed to bind specific epitopes of cancer cell surface molecules.

Scientists on the EU-funded SUPPRESSTEM (Testing and validation of bispecific antibody combinations targeting treatment-resistant cancer stem cells using organoid-based screening tools: a new drug discovery paradigm) project exploited this technology to produce human antibodies to treat CRC.

Drug development

SUPPRESSTEM researchers based their strategy on research showing that resistance to current therapies can be attributed to the presence of a small subpopulation of cancer stem cells that remains after treatment and is responsible for the re-establishment of tumours and eventual disease relapse.

As explained by the consortium, ‘the innovation behind the SUPPRESSTEM approach was the development of therapeutics that specifically targeted cancer stem cells in CRC in order to shut down important growth and differentiation pathways.’ This was achieved through bispecific antibodies that contained two different antigen-binding sites and had the capacity to bind to two different antigens or epitopes. The SUPPRESSTEM therapeutic antibodies consisted of an EGFR-targeting arm combined with an arm against LGR5, a surface molecule implicated in the Wnt signalling pathway, the most commonly altered pathway in CRC. EGFR is one of the best described survival signals in cancer, while LGR5 was originally found to mark intestinal stem cells and cancer stem cells of various types. As a result, binding and blocking these oncogenic and proliferative signals should help eliminate CRC stem cells and demonstrate an overall antitumour effect.

Drug screening in organoids

The high failure rate in cancer drug research has been linked to the poor predictive capacity of drug screening models for cancer and the inability to select the right patients for treatment.

‘Our drug was screened on a large panel of patient material and its effectiveness was linked to a particular genetic profile,’ notes project coordinator Dr Mark Throsby. Towards this goal, researchers developed a patient-derived organoid assay in collaboration with leading hospitals across Europe.

Recently, the organoid technology has been recognised as a novel paradigm technology capable of modelling human disease.

'The organoid technology is suitable for both preclinical drug development and for clinical purposes to predict personalised treatments,' Dr Hans Clevers of the Hubrecht Institute and inventor of the Organoid technology explains. The technology is being explored to determine treatment outcome of patients in clinical trials and to identify new patient groups that benefit from specific therapies.

The next goal of the SUPPRESSTEM consortium is to commercialise the patient-derived organoid assay and establish it as a universal clinical tool. Regarding the bispecific antibodies, further development for clinical testing is necessary to conclusively determine their antitumour potential in CRC patients.

SUPPRESSTEM
★ Coordinated by Merus in the Netherlands.
★ Funded under FP7-HEALTH.
★ http://cordis.europa.eu/project/rcn/108696
★ Project website: http://suppresstem.eu/

WAKE UP, WIPE OUT: HOW OXYGEN CAN HELP TAKE DOWN ANTIBIOTIC-RESISTANT BACTERIA

When hearing about bacterial resistance to antibiotics, most would picture some sort of super-bacteria that suddenly adapted and became resistant to treatment. But there is another, less known scenario: bacteria with the ability to go dormant, allowing them to slip through the net. The latter were the focus of the BIO-NMR project, which found a way to wake them up before the kill.

'Antibiotics can only kill bacteria when they are actively growing and dividing,' explains Thomas K. Wood, professor of chemical engineering and Biotechnology Endowed Chair at Penn State University. 'But, environmental stress factors often turn on a bacterial mechanism that creates a toxin that makes the cell dormant and therefore antibiotic resistant.' Such biofilm-forming bacteria are therefore very difficult to kill.

A relevant example is that of some bacteria living in the gastrointestinal track. Whilst bile can technically kill them, these bacteria can defend themselves by producing a self-toxin (protein) that makes them go dormant in its presence. As soon as the bile is gone, the bacteria produce another protein that destroys the former, and comes back to life.

Finding a way to stop the production of this toxin was key to a research effort supported in part by the EU-funded BIO-NMR (NMR for Structural Biology) project — a completed project that pooled European resources in 'Nuclear magnetic resonance' (NMR) spectroscopy. The international team, which was also supported by Spain's MINECO project and the Army Research Laboratory, actually managed to characterise the first toxin antitoxin system in a biofilm, which also happens to be oxygen-dependent.

Researchers at the NMR Laboratory, University of Barcelona, proceeded to this characterisation at the molecular and atomic level. Focusing on *E. Coli* bacterium, they found that the antitoxin's structure has channels that are just large enough for oxygen to pass through and actually relies on it. Its Hha-TomB toxin-antitoxin system implies that, in order to wake up the bacterium, the antitoxin needs to effectively oxidise the toxin.

In other words, an additional supply of oxygen could be enough to wake up the bacteria and make them sensitive to antibiotics. The researchers found that only 10 % oxygen is sufficient to wake up the bacteria on the edges of the biofilm. This could result in breaking up the biofilm and dispersing it, leaving the bacteria inside unprotected.

Wood points to the importance of this result for the development of better antimicrobials. 'If we understand the toxin-antitoxin systems at a molecular or atomic level, we can make better antimicrobials,' he said. 'I would argue that the toxin antitoxin systems are fundamental to the physiology of all bacteria. We hope this will give us insight into how they survive the antibiotics.'

BIO-NMR
★ Coordinated by CIRMMP in Italy.
★ Funded under FP7-INFRASTRUCTURES.
★ http://cordis.europa.eu/project/rcn/95876
★ Project website: http://www.bio-nmr.net/
★ http://bit.ly/2l478LY

"The researchers found that only 10 % oxygen is sufficient to wake up the bacteria on the edges of the biofilm."

TARGETED PERSONALISED TREATMENTS FOR BLOOD DISORDERS

By testing the severity of blood disorders and offering effective new targeted treatments, EU researchers hope to offer patients a better quality of life.

Developed through the EU-funded THALAMOSS (THALAssaemia MOdular Stratification System for personalized therapy of beta-thalassemia) project, new personalised treatment procedures for patients with beta thalassaemia could help save lives, reduce healthcare costs and lead to new patents for therapeutic interventions, key gene therapy innovations and gene-editing techniques. A new centralised databank of clinical information will also benefit researchers in the field.

Beta thalassaemia is a group of inherited blood disorders associated with a lack of haemoglobin, the protein that carries oxygen throughout the body. As a result, patients develop life-threatening anaemia and require lifelong transfusions. Despite improvements in treatments, thousands of babies are born with the disease every year, most commonly in Africa, India and Mediterranean countries.

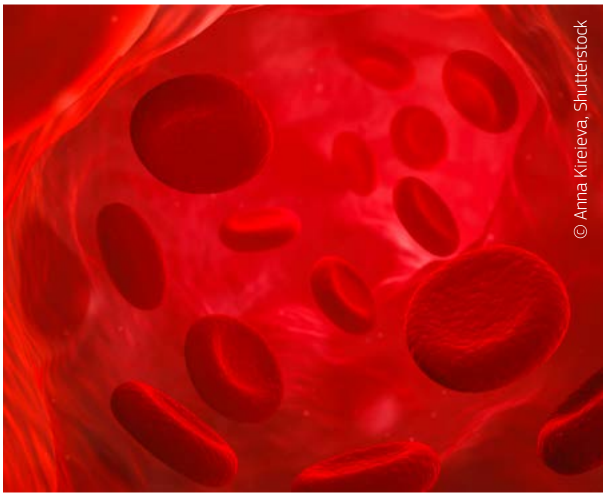
"Gambari next hopes to begin pilot clinical trials using foetal haemoglobin inducers and gene-therapy vectors, validated through the project, which have potential to be patented."

'Many of these countries are constrained by a lack of adequate blood supply, and transfusions are frequently accompanied with the risk of infection,' explains THALAMOSS project coordinator Roberto Gambari from the University of Ferrara in Italy. 'In order to address these challenges, we sought to develop more personalised therapeutic approaches.'

Gambari and his team recognised the need to reduce blood transfusions and develop new treatments in order to improve the quality of life of beta-thalassemia patients — irrespective of ethnicity, nationality and wealth — and to provide effective cost savings for healthcare systems. In particular the THALAMOSS project sought to apply therapeutic strategies in developing low-income countries where beta-thalassemia is prevalent and where current levels of care are far from optimal.

The first step of the project was to take blood samples from over 1 000 patients and use these to classify them into treatment subgroups. From this, the team was able to offer optimised personal treatments, ranging from blood transfusions through to the application of chemical inducers to increase haemoglobin production, gene therapy intervention and the correction of genomic sequences by gene-editing. 'By combining these modular techniques into an integrated approach, we hope to be able to offer comprehensive guidance for treating individual beta-thalassaemia patients,' says Gambari.

Importantly, the project also put in place infrastructure to enable multi-institutional gathering and sharing of patient data, along with guidelines to correlate findings with medical records and cell culture analyses. A centralised databank containing all clinical information to support therapeutic



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management and a thalassemia cellular biobank containing cryopreserved cells from beta-thalassemia patients were also created.

'We have more than 700 vials from more than 120 patients with different genotypes and genetic backgrounds, which can be used at any time for further experimental approaches or validation studies,' adds Gambari.

The project also made some fascinating discoveries about the disease that could aid further research. 'One of the most interesting issues was related to the extremely high levels of genetic heterogeneity among beta-thalassemia patients,' says Gambari. 'Based on this observation, beta-thalassemia appears to be a very complex genetic disease. This finding strongly supports the development of personalised approaches for beta-thalassemia patients.'

Gambari next hopes to begin pilot clinical trials using foetal haemoglobin inducers and gene-therapy vectors, validated through the project, which have potential to be patented. 'We also hope to begin fully using our cellular biobank for gene-editing strategies in collaboration with industrial and academic partners,' he adds.

'Our aim is also to finalise experiments involving non-invasive plasma analysis in order to better predict disease outcome and improve the clinical therapeutic management of patients. I'm certain that NGOs will be interested in using these low-cost therapeutic approaches in developing countries.'

THALAMOSS
★ Coordinated by the University of Ferrara in Italy.
★ Funded under FP7-HEALTH.
★ http://cordis.europa.eu/project/rcn/106261
★ Project website:
http://thalamoss.eu/

HEALTH

A SENSOR-FITTED SUIT TO ANALYSE STROKE PATIENTS' MOVEMENTS

The moment when stroke patients return home after treatment has always been a source of concern for both themselves and their physicians, as the latter are left blind without any feedback. But this is now a thing of the past: a novel suit fitted with 41 sensors is finally ready for commercialisation.

Could resorting to rehabilitation clinics be less of a necessity in the near future? Whilst these clinics effectively help patients to face post-stroke everyday life, stakeholders tend to agree that a better understanding of how these people function in the absence of medical support could lead to more effective rehabilitation at a lower cost.

This is what Bart Klaassen, PhD student at the University of Twente, and a large team of researchers from across Europe have been working on under the INTERACTION (Training and monitoring of daily-life physical INTERACTION with the environment after stroke) project. Together they developed and validated an unobtrusive and modular system for monitoring daily life activities and for training motor function in stroke subjects, in the shape of a multi-sensor-equipped suit.

This project is presented by Klaassen and his team as a world first. 'There has long been a great need for systems like this, but the technology simply was not ready,' he says. 'That is now changing rapidly, thanks to rapid developments in the fields of battery technology, wearables, smart e-textiles and big data analysis.'

The INTERACTION suit has been extensively tested on patients over a period of three months, during which they were asked to wear it under their regular clothes. The data was then transmitted, stored and processed thanks to a portable transmitter that can relay all of the information gathered through the internet to data processing servers at the University of Twente. The 41 sensors included in the suit monitor a large number of body segments, providing information on muscle strength, stretch and force.

'We have been able to demonstrate that all the information is transmitted successfully, that this process is very efficient, and much more besides,' Klaassen enthuses. 'We have succeeded in modelling all of the relevant movements, and in cleaning up the data that is relevant for the therapist by filtering out the rest. Our project has delivered new techniques and methods that can be used to monitor patients at home for extended periods of time, and to identify any differences with structured clinical measurements. We are currently engaged in further research to obtain final verification that these methods are indeed an ideal way of supervising rehabilitation.'

The press release recently published by the University of Twente says no word about a potential date of commercialisation. However, the fact that both insurance companies and healthcare professionals were involved from the early stages of the project leaves little doubt that stroke patients will soon benefit from this technological breakthrough.

"Our project has delivered new techniques and methods that can be used to monitor patients at home for extended periods of time."

INTERACTION

- ★ Coordinated by the University of Twente in the Netherlands.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/100699

A COMPACT SENSOR FOR A QUICKER RESPONSE TO NOROVIRUS OUTBREAKS

EU-funded researchers have made significant headway in developing a compact, self-contained sensor to quickly detect, analyse and report on airborne virus particles.

Every winter, Sweden's Karolinska Hospital experiences a large norovirus (i.e., flu) outbreak. As a result, hundreds of staff and thousands of patients are incapacitated for several days and entire wards are closed down. This in turn costs hundreds of thousands of euros, significantly delays lifesaving operations and severely diminishes the healthcare capacity of the greater Stockholm area.

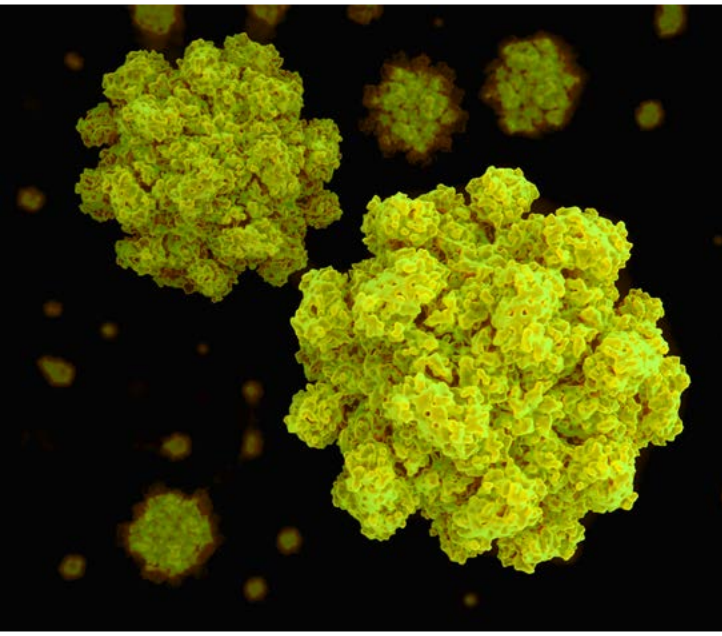
Of course this phenomenon isn't limited to Karolinska Hospital, but is a recurring theme in hospitals, day-cares, retirement homes and workplaces across the globe. Without effective countermeasures put in place, these crippling outbreaks will continue winter after winter after winter.

The challenge to combating and containing an outbreak is a significant lack of precise information on the location of high virus concentrations. To bridge this gap, the EU-funded NOROSENSOR (A real-time monitoring system for airborne norovirus) project developed core technology for an advanced virus sensor prototype. The sensor can be used to monitor the concentration of airborne viruses and other pathogens in high risk areas, such as hospitals, retirement homes, cleaning companies and cruise ships.

Small but mighty

Traditional air sampling methods rely on highly specialised equipment and subsequent transportation of the samples to a central lab for analysis — which is not cost efficient and takes time. 'Although effective, such a system is ill-suited for monitoring multiple locations or screening outside a laboratory, both prerequisites for combating an outbreak,' says project coordinator Fredrik Carlborg.

The project's sensor, on the other hand, combines low-power electrostatic air to liquid sampling, compact microfluidics sample preparation and novel molecular tools to attain very low detection limits of virus particles in the air. High sensitive quartz crystal technologies or similar digital technology provide a read-out within the sensor unit itself. The compact unit can be powered by batteries and is small enough to be easily transported.



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Although the project was unable to test the sensor outside a controlled laboratory setting, its prototype testing successfully analysed and reported on the finding of airborne virus particles. 'Until further testing is completed, it looks like the sensors first use will be as a companion to the many air purification systems currently on the market,' says Carlborg. 'Although these systems can clean the air, they cannot measure what they cleaned and how much. With the addition of the Norosensor, they will now have this capability.'

"By knowing the virus concentration in the air, a hospital can more easily pinpoint the source of an outbreak or implement more focused contamination steps, allowing them to open a closed ward faster."

According to Carlborg, when ready for use as a stand-alone system in a hospital setting, the first application may be to monitor and control air and ventilation after or during a norovirus outbreak. 'By knowing the virus concentration in the air, a hospital can more easily pin-point the source of an outbreak or implement more focused contamination steps, allowing them to open a closed ward faster,' he says.

Market potential

The technologies developed in the NOROSENSOR project are set to enable a quick and efficient response to norovirus outbreaks, thus reducing human suffering and limiting the impact and costs these outbreaks have on society. By enabling the early containment of virus epidemics, closures due to staff illness are minimised — resulting in billions of euros in savings.

'When this technology hits the market, it will be the first efficient tool for the direct sampling of airborne norovirus in connection with an outbreak,' says Carlborg. 'This enables much more timely and accurate epidemiological data to be collected during outbreaks than was previously possible, thus allowing a hospital such as Karolinska to break the annual winter norovirus cycle.'

NOROSENSOR
- Coordinated by the Royal Institute of Technology in Sweden.
- Funded under FP7-NMP.
- http://cordis.europa.eu/project/rcn/110979
- Project website: http://www.norosensor.eu/

THERE IS SUCH A THING AS AN EMOTIONAL HANGOVER

Research partly supported through the EU-funded EMOTIONAL MEMORY project has shown that emotional experiences can induce psychological and internal brain states that persist for much longer after the emotional experience has ended.

The research published in the journal 'Nature Neuroscience' shows that such an emotional 'hangover' influences how we address and remember future experiences. It has been known for quite some time that emotional experiences (such as weddings, funerals, first kisses, historic events, childbirth or the death of a loved one) are better remembered than non-emotional ones, not only minutes after the event has occurred but even years later.

For example, more than 15 years on from the event, many people are still able to recall vividly where they were and what they were doing when they first heard about the terrible events that unfolded in the United States on 11 September 2001. However, this study also demonstrated that non-emotional experiences that followed emotional ones were also better remembered during a later memory test.

'How we remember events is not just a consequence of the external world we experience, but is also strongly influenced by our internal states — and these internal states can persist and colour future experiences,' explained Lila Davachi, an associate professor at New York University (NYU). 'Emotion is a state of mind. These findings make clear that our cognition is highly influenced by preceding experiences and, specifically, that emotional brain states can persist for long periods of time.'

To obtain these findings, subjects were asked to view a series of scene images that contained emotional content and elicited arousal. Approximately 10 to 30 minutes later, one group then also viewed a series of non-emotional, ordinary scene images. Another group of subjects viewed the non-emotional scenes first followed by the emotional ones. Psychological arousal, measured in skin conductance, and brain activity, using fMRI, were monitored in both subject groups. Six hours later, both sets of subjects were administered a memory test of previously viewed images.

The researchers hypothesised that the carry-over effects of emotional experiences would manifest in low-frequency amygdala connectivity. Therefore, the researchers also examined whether this type of brain activity, present during emotional memory encoding, was also present during the neutral memory encoding phase in the two groups.

> *"Such a state as can be described as an 'emotional hangover' does indeed exist and can have long-lasting effects on the capacity of the brain's ability to process and recall memories."*

The results showed that the first group of subjects who were exposed to the emotion-invoking stimuli first had better long-term recall of the second set of more neutral images than the second group, who saw the emotional images second.

It was by looking at the fMRI results that unlocked the explanation for this — it seems that the brain states associated with emotional experiences carried over for 20 to 30 minutes and influenced how the subjects processed and remembered future experiences that were not emotional. In short, such a state as can be described as an 'emotional hangover' does indeed exist and can have long-lasting effects on the capacity of the brain's ability to process and recall memories.

The EMOTIONAL MEMORY (Effects of emotion and stress on different memory phases) project is being carried out by the University of Geneva and is due to complete in February 2018. The study also received support from the US National Institute of Mental Health, the Swiss National Science Foundation and the German Research Foundation.

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EMOTIONAL MEMORY

- Coordinated by the University of Geneva in Switzerland.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/project/rcn/108612

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SOCIETY

EXPLORING THE VICTORIAN CRAZE OVER THE FEAR OF CATS

The EU-funded DISEASES project has been exploring how the Victorians diagnosed, understood and dealt with many of the phenomena related to stress and overload that characterise today's modern globalised society. One intriguing discovery has been on the Victorian emphasis on phobias, particularly ailurophobia — the fear of cats.

Phobias are a normal part of every day and most people will admit to having at least one (for your writer, enclosed spaces and clowns). However, it was really only in the late nineteenth century that medicine turned its attention to forms of irrational fears, as the DISEASES (The Diseases of Modern Life: Nineteenth-Century Perspectives) project has been finding out.

Its research highlights how it was a German physician, Carl Westphal, who made the initial diagnosis of agoraphobia (fear of open spaces) in 1871 after studying three otherwise sane and rational professional men who were terrified when having to cross an open city space. Following this diagnosis, the notion that such individuals could be overtaken by various forms of inexplicable fear was quickly taken up by both medical practitioners and the era's popular culture.

Indeed, American psychologist G. Stanley Hall identified 136 different forms of pathological fear, all possessing their own Greek or Latinate names. These included more commonly recognised phobias such as agoraphobia and claustrophobia but also some very Victorian-esque fears, including amakophobia (fear of carriages), pteronophobia (fear of feathers) and hypegiaphobia (fear of responsibility).

However, one phobia that attracted a particularly high amount of attention from Victorian contemporaries was ailurophobia — the fear of cats. Hall, along with his colleague Silas Weir Mitchell, sent out forms and questionnaires to try and understand the various forms and potential causes of this feline fear. Mitchell went further, trying to ascertain whether the claims of some sufferers that they could always detect if a cat was in a room (even if they couldn't see or smell it) were in fact true.

He conducted experiments, such as placing sufferers into a room with a hidden cat, to see if they picked up the animal's presence. Initially sceptical, he eventually became more convinced that many of his patients could always sense them. When trying to account for the phobia, he ruled out asthma and evolutionary inherited fears (for example, people who are scared of cats are perfectly fine to look at lions, tigers etc.).

Eventually he suggested that emanations from the cat 'may affect the nervous system through the nasal membrane, although recognised as odours.' He also remained baffled over why cats seemed to have an urge to get as close as possible to individuals who were scared of them — 'even strange cats seem to have an unusual desire to be near them [ailurophobia sufferers], to jump on their laps or to follow them.'

According to the DISEASES project team, the Victorian urge to classify a vivid cultural and psychological map of fears and anxieties was the result of a rapidly changing, industrialising society, where new scientific theories were starting to challenge long-held religious explanations and dogma.

Consequently, in an age reminiscent of our Victorian forbearers, where societies are again struggling to adapt to rapid technological, social and economic changes, DISEASES aims to engage the Victorian experience to better understand and contextualise our own twenty-first century response to modernity's continued challenges. The project, coordinated from Oxford University, will run until January 2019 and has received just over EUR 3.5 million in EU funding.

"Emanations from the cat may affect the nervous system through the nasal membrane, although recognised as odours."

DISEASES
★ Hosted by the University of Oxford in the United Kingdom.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/110493

UNDERSTANDING AN OVERLOOKED PERIOD OF ISLAMIC HISTORY

EU-funded researchers have created a database of previously unavailable Arabic, Persian and Turkish texts dating from the 13th to 16th centuries.

According to most history books, the Islamic empire came to an official end with the Mongol conquests of the Middle East during the mid-13th century. Although by this time the empire had well-surpassed its Golden Age and had entered into a general state of decline, this conquest served as the final nail in the coffin. End of story. Or is it?

According to research conducted by the EU-funded IMPACT (From Late Medieval to Early Modern: 13th to 16th Century Islamic Philosophy And Theology) project, the influence of the Middle East's Mongol moment far exceeds the textbook definition of merely marking the end of the Abbasid Caliphate in Baghdad. Instead, it marks the beginning of a protracted era of enlightenment where, in the face of fundamentally changing socio-political realities, Muslim philosophers set off to redefine the very core of Islam.

Despite the intense change happening, the period between the dissolution of the Abbasid Caliphate and the establishment of the early modern regional states of the Ottomans, Safavids and Mughals remains one of the most understudied periods in the history of the Nile-to-Oxus region. It is this historic middle section that was the focus of the IMPACT project.

A collaborative effort

As a result of the rise of Persian and Turkish as literary languages, in addition to Arabic, one must have a wide linguistic knowledge to be able to scrutinise the texts produced during this period — which makes studying the 13th to 16th centuries a challenge. 'As a consequence, the majority of the texts from this period remain unpublished — and this was the core focus of our research,' says Project Lead Judith Pfeiffer. 'Our objective was to overcome the current fragmentation of the existing expertise across Europe, the Middle East and North America.'


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To accomplish this, the project collaborated closely with other projects happening in related fields, often bringing a wide range of experts together for international workshops and conferences. The project also focused on encouraging and engaging with young researchers by providing graduate students travel grants and establishing post-doctoral research positions. The project was further supported by the editing and translating of key texts and the publication of important monographs. 'As a result of these combined efforts, IMPACT enabled associated researchers to devote themselves to the in-depth study of a specific topic for an extended period of time without the distractions of academic administration,' says Pfeiffer.

A database of insight

The cumulation of this expansive research is the launch of an open-source, open-access and fully searchable database. Here, for the first time, future researchers can find a plethora of published and unpublished Arabic, Persian and Turkish works on the rational sciences dating from 13 – 16th centuries.

'By studying the texts, authors and intellectual networks of the 13th-16th century period of the Nile-to-Oxus region, we have made this crucially important, but much neglected, part of history accessible,' says Pfeiffer. 'We successfully bridged the gap between the much more heavily studied classical and modern periods of Islamic intellectual history, thus enabling scholars to study the intellectual and political history of the period, both in its own right and in a holistic manner.'

IMPACT
★ Hosted by the University of Oxford in the United Kingdom.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/97076

DNA EXCAVATIONS UNCOVER INDIGENOUS GRAIN SUBSISTENCE ON THE CANARY ISLANDS

Supported through the EU-funded PALEOPLANT project, a series of genetic analyses of prehistoric seeds have unearthed millennium-old barley on the Canary Islands, shedding light into native Canarian origins.


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Up to a thousand year-old barley seeds hidden away by the indigenous population inside volcanic rock silo systems and mountainous caves have allowed researchers to conduct unprecedented genotyping of archaeobotanical specimens. This study helps bring about a better understanding of human subsistence from the Palaeolithic and Epipalaeolithic prehistoric periods to the modern day.

'The conditions in these caves were ideal for storage, and it is possible today, more than 500 years later, to find intact seeds in some of the most remote and well-hidden caves,' explained Jacob Morales from the University of Las Palmas de Gran Canaria, and one of the main study researchers.

The results published in the 'Journal of Archaeological Science' have revealed striking genetic similarities between Canarian barley found today and in prehistoric times. The joint study, involving academics from Spain's University of Las Palmas de Gran Canaria and Linköping University in Sweden, genotyped 640 individual barley grains and made a comparative analysis of over a hundred different genetic variants from the Canary Islands, in northern Africa and the western Mediterranean, cultivated through various time periods. Crucially radiocarbon dating (AMS) indicated that the age of some the seeds found ranged from 1050 to 1440 cal AD and most likely from the pre-Hispanic era.

In short, compared with seeds emanating from mainland Africa and Europe, researchers have now managed to unearth Canarian archaeological material barley that has a unique genetic cluster going back centuries and before the conquest of the Canary Islands by the Crown of Castille.

'Since the original population has been replaced to a large extent by people from Spain, we were interested to see whether the barley had also been replaced. We found, however, that what is cultivated on the Canary Islands today is exactly the same barley as the original population brought to the islands when they were colonised early in the first millennium AD,' asserted Jenny Hagenblad, associate professor at Linköping University and a study co-author.

Whilst the exact origins of the indigenous people — the Guanches — in the Canaries are the subject of many theories and debates, what is now certain is that barley has been exceptionally preserved as the main crop on the islands. Starting with the indigenous peoples protecting and even hiding their valuable harvest in prehistoric caves, through Hispanic settlers in the 14th and 15th centuries, to today's farming community, this seed seems forever ingrained into the Canary Islands' DNA.

'We also learned a great deal about the barley that was cultivated in prehistoric times. The genetic markers we have used show that the barley had a high nutritional content, and each plant produced many seeds. The barley seems to have been well adapted to the conditions on the Canary Islands, and this is something that the Spanish conquerors probably noticed,' stressed Matti Leino, associate professor at the Nordic Museum and previously at Linköping University.

"The genetic markers we have used show that the barley had a high nutritional content, and each plant produced many seeds."

These findings of genetic similarity now provide the exciting prospect of conducting future population studies of ancient archaeological DNA remains on a larger scale to further reveal Earth's buried history.

The PALEOPLANT (Palaeolithic Plant Use in the Western Mediterranean) project, which officially ended in December 2015, aimed to better understand how plant foods and resources were used by pre-agrarian societies. The project received nearly EUR 385 000 in ERC funding.

PALEOPLANT
- Hosted by the University of the Basque Country in Spain.
- Funded under FP7-IDEAS-ERC.
- http://cordis.europa.eu/project/rcn/185568

TWITTER ANALYSIS SHOWS IMMIGRATION DROVE UK LEAVE VOTERS

Six months on from the UK's decision to leave the European Union, researchers are still trying to ascertain how and why the Leave campaign was ultimately victorious. In new research partly supported by the EU-funded PHEME and SOBIGDATA projects, 3 million tweets were analysed over a 6-month period that showed immigration was by far the most important issue driving Leave voters.

Researchers based at the UK's University of Sheffield, funded under the PHEME (Computing Veracity Across Media, Languages, and Social Networks) and SOBIGDATA (SoBigData Research Infrastructure) projects, identified 41 443 Leave supporters and 41 445 Remain supporters based on their pattern of using campaign hashtags on Twitter in the run-up to the referendum date. They then analysed the issues those users tweeted about in relation to Brexit every day from June to November (e.g. #VoteToLeave, #SaferIn).

However, in order to remain as accurate as possible, for tweets containing Leave/Remain hashtags, only the last hashtag used was considered by the researchers as the one indicating the tweet's intended stance (pro-Leave or pro-Remain). They also filtered out all users with fewer than three stance-expressing tweets. This allowed them to arrive at a more reliable sample of Twitter Leave/Remain supporters.

In order to break down tweets into topics, the research used the UK Government's stated high-level 'policy areas', such as public health, immigration and law. For each of these topics, sets of keywords were linked to them (e.g. for public health: NHS, nursing, doctors), which were taken automatically from party manifestos and UK election tweets, then post-edited and extended manually. This was also complemented by a more traditional search-based approach in order to capture statistics on popular Brexit-specific topics (such as 'Article 50').

Lessons from Twitter

The analysis showed that in the run-up to the referendum, Leave voters sent twice as many tweets about borders and immigration as they did about sovereignty, employment, the justice system or the National Health Service (NHS). The issue of law and justice, though far behind immigration, was still a major issue for Leave voters, who sent 4 times as many tweets on this topic as Remain supporters.

Another one of the most interesting findings from the research was that although Twitter is often seen more as a liberal echo chamber, in the month running up to the referendum it was Leave supporters who were tweeting most actively, with immigration and the economy being the most active topics. After the referendum, Remain voters tweeted more actively across all topics, closing the gap with Leave voters. However, Twitter acted more as an echo chamber overall, with only 7 % of tweets being replies and over 58 % being retweets, although it was noted that Leave voters made more effort to spread their views.

The gap between the number of tweets from Leave and Remain supporters about borders and immigration became most apparent in the final week of the referendum campaign, with a large surge in tweets from Leave supporters. This coincided with the release of a now infamous poster by Leave.eu (which was not the official Leave campaign) showing a queue of refugees. The poster gave the impression that the individuals depicted were heading specifically to the UK, whilst the photo was actually taken on the Croatian-Slovenian border.

'The key challenge and benefit of this work is in getting the insights in real time,' commented senior study researcher Kalina Bontcheva. 'This means always having up-to-the-minute knowledge of the topics, participants, and opinions, and being able to study changes in these over time.'

Whilst the researchers are careful to insist that Twitter and other social media channels cannot by themselves explain the complex reasons behind some of the most unexpected political events of 2016, such as the UK public's decision to go for Brexit, they do highlight that social media allows for the study of the general public's immediate reaction to ongoing events in almost real time. This thus complements traditional polling methods that have had less than a stellar record in accurately making predictions in what has been a politically tumultuous year.

SOBIGDATA / PHEME

- ★ Coordinated by the National Research Council in Italy / the University of Sheffield in the United Kingdom.
- ★ Funded under H2020-INFRAIA / FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/197882
- ★ http://cordis.europa.eu/project/rcn/191627
- ★ SOBIGDATA website: http://project.sobigdata.eu/
- ★ PHEME website: https://www.pheme.eu/

THE COMPLEXITIES OF INTEREST GROUPS IN EU LOBBYING

Interest groups that lobby across different EU policy areas can have an important impact on policymaking. An EU-funded project has investigated the mechanisms behind their lobbying success.

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Throughout the young history of the EU, different interest groups have often successfully lobbied for or against different causes and issues, significantly influencing politics in the bloc. The EU-funded project EULOBBYING (Interests, demands and network ties in Brussels: Explaining interest groups' lobbying success across EU policy areas) looked at how interest groups' policy demands impacted the policymaking process and led to policy outcomes. It looked at the factors that decide interest groups' success in influencing EU legislative proposals.

To understand interest groups' participation in policy formulation and policy shaping, the project investigated several issues at the supranational level of governance. It closely studied how the groups' policy demands affected the policymaking process and policy outcomes, examining policy positions and preferences as well.

This was achieved through intensive data collection, theory building and theory testing for different policy positions and proposals. The latter included the EU's Better Regulation package, Inter-Institutional Agreement on Better Lawmaking, adoption of new Stakeholder Consultation Guidelines, and proposal for a mandatory Transparency Register.

Overall the project's outcomes show that the EU stakeholder consultation regime alleviated bias in interest representation. They also highlight that coordinated advocacy and lobbying campaigns are organised by interest groups very early on in the EU policymaking process through open consultations.

The findings provide valuable insight regarding interest groups' lobbying behaviour and influence strategies. They reveal that stakeholders' demands for reforming the EU Better Regulation policy involve technocratic deregulation and policymaking, as well as participatory policymaking and social Better Regulation.

Importantly, the results highlight three distinct interest group clusters: those satisfied with the Joint Transparency Register, those seeking to better regulate lobbyists' access to the European Parliament, and those who criticise the Register. The first cluster mostly comprises business organisations, while the third is for the most part formed by organisations that represent public interests. It is worthy to note that half of the stakeholders expressed positive evaluations of the EU Transparency Register.

"Overall the project's outcomes show that the EU stakeholder consultation regime alleviated bias in interest representation."

EULOBBYING unravelled the structure of stakeholders' positions regarding Better Regulation issues. This ultimately facilitates compromise solutions and consensual decision-making. On the other hand, weak stakeholder alignments and unstable advocacy coalitions may help other bodies shape the Better Regulation reforms. Lastly, project work underlined that significant differences among interest groups regarding the current EU lobbying regulatory scheme should be noted.

EULOBBYING

- ★ Coordinated by University College London in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/project/rcn/187702_en.html

TRANSPORT

ACCURATE CONDITION MONITORING FOR AERO ENGINES

EU-funded researchers have developed advanced sensors to collect accurate and reliable temperature measurements from all parts of aero engines under extreme conditions.

The efficiency of gas turbine engines increases with increasing gas temperature, allowing for a significant reduction in fuel consumption and carbon dioxide emissions. To achieve this reduction, the engine parts are protected by 'Thermal barrier coatings' (TBCs). These ceramic materials are able to withstand high temperatures and minimise the thermal input to the substrate.

The EU-funded project STARGATE (Sensors towards advanced monitoring and control of gas turbine engines) was launched to develop the technology needed to measure the critical parameters of thermal insulation layers up to temperatures of 1 600 °C. During the project's three-year lifetime, researchers succeeded in surpassing the limitations of existing sensors.

Among the sensors developed is an infrared radiation thermometer. Unlike short-wavelength infrared-range thermometers currently used, the new instrument is particularly suitable for non-contact temperature measurements of the surfaces of TBCs. Ceramics are semi-transparent in the short infrared region of the electromagnetic spectra, but not in the long infrared range.

In addition, STARGATE partners designed and validated a high-temperature pyrometer able to measure thermophysical properties of TBCs. Specifically, the thermal conductivity of the coating and the degree of emission of its surface can be measured *in situ* during gas turbine operation. Importantly, meaningful values would be obtained for use in optimising turbine operation.

STARGATE technology is expected to contribute to improving the next generation of green and efficient aero engines. To date, gas turbines have been operated within safety margins safeguarding parts from mechanical failure because of the uncertainty in key parameter measurements. However, with the new sensing technology, it will be possible to operate these close to the maximum operating ceiling.

STARGATE
★ Coordinated by Meggitt in the United Kingdom.
★ Funded under FP7-TRANSPORT.
★ http://cordis.europa.eu/project/rcn/104300

MORE SECURE SHIP REPORTING SYSTEMS FOR MARITIME SAFETY

New security solutions are under development to minimise or eliminate malicious threats to on-board ship reporting systems.

Maritime control and surveillance depends heavily on 'Ship reporting systems' (SRSs), which are vulnerable to attacks by dishonest operators or criminals. With inexpensive technology now available that can be exploited to compromise these systems, it is crucial for the maritime sector to prevent such malicious attacks.

Against this backdrop, the EU-funded TRITON (Trusted vessel information from trusted on-board instrumentation) project worked on upgrading on-board equipment in reporting systems. These include vessel monitoring systems and automatic identification systems, as well as long-range identification and tracking.

To achieve its aims, the project team developed a more robust and secure global navigation satellite system receiver that is impervious to jamming and spoofing attacks. The team also upgraded very-high-frequency communication between vessels and with

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land-based stations to ensure better security and communication reliability.

TRITON also analysed state-of-the-art reporting systems, evaluated potential risks and studied relevant legislation. It identified and evaluated security threats in order to establish specifications for designing and developing better equipment. After analysing the best ways to detect jamming and mitigate spoofing, the project proposed feasible and viable security solutions to integrate aboard vessels.

Towards the end of the project, the team tested new high-tech solutions that can effectively guard against intentional interference and malicious attacks. It designed a prototype that demonstrated the proof of concept, supported by a test campaign at the Joint Research Centre of the European Commission in Ispra, Italy.

The final project results included guidelines to advance policymaking and regulations in light of emerging maritime applications and advantages. With more secure surveillance and safety systems, civilian and commercial maritime control is bound to become much more efficient.

TRITON
★ Coordinated by ISMB in Italy.
★ Funded under FP7-SECURITY.
★ http://cordis.europa.eu/project/rcn/111021
★ Project website: http://tritonproject.eu/

WIDER APPLICATION OF NEW MATERIALS FOR LIGHTER AND GREENER TRAINS

The implementation of new lightweight materials for trains has been slow due to the lack of suitable certification procedures. However, an EU initiative has paved the way for the certification of new materials.

New materials such as composites can help to build lighter rolling stock that will consume less energy and reduce emissions. While such materials are being used in the manufacturing of rolling stock parts, there is no way to certify a rail vehicle built mostly or entirely from non-metallic materials. The existing regulatory framework must be re-examined in order for the sector to recognise what changes are needed.

With this in mind, the EU-funded REFRESCO (Towards a regulatory framework for the use of structural new materials in railway passenger and freight carbodyshells) project set out to provide recommendations and the information needed to adapt the regulatory framework of railway carbody structures to the introduction of new materials.

Work began by benchmarking the most promising new materials available to railway and other sectors, and examining rail certification processes and standards to identify gaps which need to be filled ahead of implementing new materials.

Project partners studied fire, smoke and toxicity properties of resins, the noise, vibration and harshness of composite materials, and the advantages and disadvantages of composite materials concerning electromagnetic compatibility. They investigated existing standards, and characterised and modelled procedures for the new structural materials. This was done to understand the structural requirements for issues arising from the replacement of metal with high-performance composite materials in rail carbody shells.

The REFRESCO team examined the crashworthiness of rail vehicles and parameters of the manufacturing process that influence final material properties. It proposed optimal prognostic, health management and non-destructive methods for new materials in rail carbodies.

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Lastly, recommendations were proposed for modifying current railway standards in order to enable the safe introduction of new materials in train carbodies.

REFRESCO introduced a framework for implementation of new structural materials for rolling stock. Standardisation has the potential to make the European rail industry a pioneer in using structural materials for trains.

REFRESCO
★ Coordinated by UNIFE in Belgium.
★ Funded under FP7-TRANSPORT.
★ http://cordis.europa.eu/project/rcn/110242
★ Project website: http://www.refresco-project.eu/

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ENVIRONMENT

REACHING GLOBAL WARMING TARGETS UNDER ICE-FREE ARCTIC SUMMERS REQUIRES ZERO EMISSIONS BY 2045

Ice-albedo feedback as a result of sea-ice melting, notably in the Arctic, is known to reinforce global warming. What is less known, however, is the impact of a no-summer ice scenario on the world's ambition to maintain global warming below 2 °C by 2100. A study conducted under the TRANSRISK project paints a rather dark picture, highlighting the need to better understand the impact of rapid climate change in the region.

More stringent mitigation efforts globally.' This is what researchers of the Basque Centre for Climate Change (BC3) have come to recommend after studying the potential consequences of an Arctic ice-free month of September 2050 — something doomed to happen according to the IPCC's Fifth Assessment Report.

Whilst in line with the growing number of pessimistic studies on the pace and impact of climate change, the new study takes a new approach, highlighting the remaining gap in our understanding of the Arctic's role in the regulation of Earth's temperature. It considers the implications of climate change mitigation to below 2 °C levels in the presence of the SIAF — a process that sees sea-ice melting, resulting in more open water being exposed to solar radiation, absorbing more energy and generating a self-reinforcing warming mechanism.

Although important, this feedback process is currently not incorporated into integrated assessment models. This led the TRANSRISK (Transitions pathways and risk analysis for climate change mitigation and adaption strategies) team to study the consequences of a sea-ice-free month of September 2050 and, in light of the current debate about a potential recovery of Arctic sea ice in a low-carbon scenario, they decided to consider three potential trajectories following this no-ice scenario: partial recovery, stabilisation, and continued loss of sea ice.

'The sooner the sea-ice-free condition occurs, the more difficult it will be to control climate change, especially if sea-ice recovery does not occur,' the study reads. 'Emissions reductions should increase significantly compared to current mitigation scenarios that do not include Arctic sea-ice loss.'

The team highlights measures that should be taken, notably a quicker replacement of existing energy infrastructures and earlier adoption of policy instruments that could make such improvements feasible. All in all, the studied scenario shows that the only way to achieve the 1.5 °C target in the presence of SIAF would be through negative emissions, which means that the implications of considering Arctic sea-ice-free conditions for the transformation of the global energy system are 'severe.'

'We find that global CO_2 emissions would need to reach zero levels 5-15 years earlier and that the carbon budget would need to be reduced by 20%-51% to offset this additional source of warming,' the study concludes. 'The extra mitigation effort would imply an 18%-59% higher mitigation cost to society. Our results also show that to achieve the 1.5 °C target in the presence of ice-free summers negative emissions would be needed.'

The team also insists that future research should focus on more precise scenarios of sea-ice loss derived directly from physical models. Indeed, SIAF is not the only feedback process that had yet to be considered.

TRANSRISK

★ Coordinated by the University of Sussex in the United Kingdom.

★ Funded under H2020-SC5.

★ http://cordis.europa.eu/project/rcn/196826

★ Project website: http://transrisk-project.eu/

EUROPEAN INFRASTRUCTURE FOR ECOSYSTEMS RESEARCH

Ecosystem science is receiving a major boost thanks to an EU-funded initiative that has developed experimental and theoretical platforms to monitor and assess ecosystems and the social and agricultural services they provide.

Europe's natural and cultivated land is under pressure from land-use change, population growth and climate change. To maintain the services it provides, land managers and scientists require better forecasting tools.

This need is being addressed by the ANAEE (Infrastructure for analysis and experimentation on ecosystems) project. Its aim is to support scientists in their analysis, assessment and forecasting of the impact of climate and other global changes in the services that ecosystems provide to society. According to project coordinator Dr Abad Chabbi: 'ANAEE aims to transcend traditional barriers by working together to realise a broader vision of international collaboration, thereby enabling ANAEE to resonate both in Europe and globally.'

The initiative provides researchers with the necessary 'research infrastructure' (RI) needed to understand and model the functioning of managed and wild ecosystems and to better develop the bioeconomy. 'ANAEE will advance our ecological knowledge as well as our analytical and decision-making tools for a combined societal benefit,' says Dr Chabbi.

A vision document has identified the services this RI will provide, especially through a Central Hub headed by a Director-General plus three supranational Service Centres (experimental, analytical and modelling). 'The coordination and integration of national platforms through the latter will ensure international access, improved measurements and data harmonisation, technology development, links between data and models, and open access to data,' Dr Chabbi explains.

The technical criteria that the distributed national platforms should meet in order to belong to ANAEE have also been developed. Among the national platforms having expressed their interest in ANAEE, over 100 were short-listed, based on criteria of excellence. Because each has its own protocols and instrumentation, they will receive any necessary upgrades prior to joining the ANAEE RI.

Dr Chabbi states: 'This will both optimise the cross-use of platforms in pan-European experiments and ultimately engage individual platforms to take an active role in meeting ANAEE's key challenges.' Thus, the uniqueness of ANAEE's approach to ecosystem science stems from its capacity to engage with a range of National Platforms.

They include natural, open air platforms, hosting *in situ* experiments, and represent a large range of managed and natural ecosystems that reflect the continent's different climatic and land-use conditions. Enclosed platforms featuring highly controlled environments experimentally test the response of ecosystems to extreme events, natural hazards and climate change.

In addition, analytical platforms employ novel techniques and state-of-the-art equipment to better characterise the state of ecosystems and explore unknown processes, while model platforms specialise in model building and simulations.

The conditions for future access to these platforms and the data that they collect have been established, as has the involvement of industry. The legal and governance aspects have been agreed upon with the view to creating a European Research Infrastructure Consortium (ERIC). Furthermore, the financial and human resources required to run the ANAEE RI have been evaluated and a business model developed.

ANAEE will allow both scientists and society as a whole to increase their understanding of ecosystem processes and the corresponding drivers of change. It will also allow the research community and decision-makers to respond to the growing threats generated by climate change and support the European Research Area (ERA) by understanding and detecting feedback mechanisms and providing high-quality data.

According to Dr Chabbi, ANAEE will 'impact on Europe's bioeconomy by championing innovation, generating new market opportunities and strengthening competitiveness.'

The project will support industries as innovation developers or as customers, thereby increasing the technological and organisational readiness to develop new ecosystem experiments. ANAEE will also train the next generation of scientists and decision-makers to maximise the potential of the collected data.

"The project will support industries as innovation developers or as customers, thereby increasing the technological and organisational readiness to develop new ecosystem experiments."

ANAEE

- ★ Coordinated by INRA in France.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ http://cordis.europa.eu/project/rcn/104924
- ★ Project website: http://www.anaee.com/
- ★ http://bit.ly/2lGoPEn

ENVIRONMENT

UNDERSTANDING TROPICAL FOREST BEHAVIOUR IN EARTH'S CHANGING CLIMATE SYSTEM

Supported through the EU-funded T-FORCES project, scientists have found that biodiverse forests did not boost carbon storage beyond a certain point.

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Tropical forests play a key role in the global carbon cycle, harbouring at least half of all species on the planet as well as storing 250 billion tonnes of carbon. This led a team of scientists from 22 countries to examine both the tree diversity and amount of carbon stored in 360 locations across the lowland rainforests of Africa, Asia and the Amazon to determine the exact change and sensitivity of forests to the ongoing challenges of global climate change.

The results, published in the journal 'Scientific Reports', interestingly reveal that biodiversity in tropical forests does not guarantee more carbon overall.

'In many ecosystems, sites with more species tend to lock up more carbon. But this doesn't work for tropical forests. Most tropical forests already have many species, and it may be that beyond a certain point adding even more species makes no difference to carbon stocks,' highlighted co-author, Dr Joey Talbot, from the University of Leeds.

In total 200 000 trees were measured in the study using the diameter and identity of every tree within a given hectare (2.5 acres). African tropical forests stored high levels of carbon, but are the least diverse and the Amazon, which has a great diversity of tree species, tends to store less carbon per hectare than forests in Africa and Asia.

Nevertheless, protecting biodiverse tropical forests remains essential, both to secure a future for millions of species, and to meet the global commitment of keeping temperature increases well below 2 degrees Celsius. These forests are potentially critically sensitive to climate change, and their fate is closely tied to processes that will affect the rate of global climate change this century.

'The wonderful diversity of tropical forests, with millions of plant and animal species, is something we rightly celebrate. And now forests face rapidly changing climates, so conserving the full variety of life present could make a critical difference in allowing them to adapt,' stressed co-author, Professor Oliver Phillips, from the School of Geography at Leeds and leader of the RAINFOR forest monitoring network in the Amazon.

Such findings give us an increased global picture of the current condition and trajectory of tropical forests as the climate change threat begins to unfold. 'It's critically important to keep this carbon out of the atmosphere. But we need to remember that forests are more than just sticks of carbon. Local community uses, species diversity, and the many other values of forests should be taken into account to plan adequate conservation strategies for the 21st century. A simple focus on carbon is never enough,' warned co-author, Professor Simon Lewis, also from the School of Geography at Leeds and founder of the AfriTRON forest monitoring network in Africa.

The T-FORCES (Tropical forests in the changing earth system) project officially ends in June 2017 and aims to deepen our understanding of the role of tropical forests in the global carbon cycle — both present and future. The project received EUR 2 500 000 in ERC funding.

T-FORCES

★ Hosted by the University of Leeds in the United Kingdom.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/103919
★ Project website:
http://www.tforces.net/

ASSESSING INDIVIDUAL PREFERENCES OF EUROPEAN CITIZENS IN AIR QUALITY POLICIES

An EU project supported the review of air quality policies through a socio-economic analysis of individual behaviours and choices, from the local through to the European scale.

The EU-funded SEFIRA (Socio-economic implications for individual responses to air pollution policies in EU +27) project was designed to support the review and implementation of air quality legislation, thus improving its effectiveness and acceptability.

This aim has been achieved through the coordination of trans-disciplinary scientific and socio-economic resources. Air quality policies are not implemented in a social vacuum; they require continuous interaction with individuals, often implying significant changes in their lifestyles. In addition, the extent to which people endorse a policy is crucial in determining its effectiveness and success at both national and regional scales. However, while there is a broad consensus that public acceptability affects both the effectiveness and success of environmental policies, acceptability has not been fully studied and internalised in the models used to support the policies' adoption.

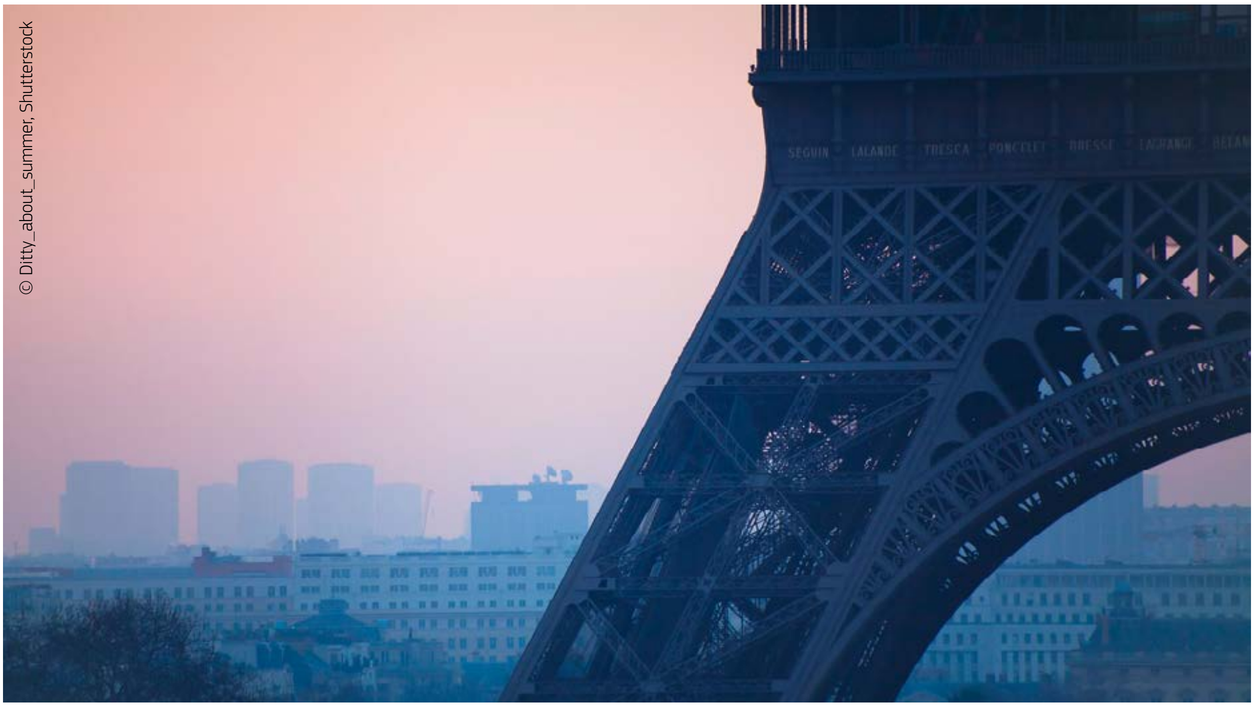
Exploring different quality and quantitative approaches, the SEFIRA consortium identified discrete choice analysis as a powerful tool in supporting the decision-making process in particular when the implementation process involves behavioural changes. Indeed, discrete choice experiments allow for investigating people's preferences and their potential behaviour, identifying variables affecting individual choices between two or more 'choice alternatives'.

Within SEFIRA, a choice experiment was conducted, based on 16 100 interviews carried out in seven European countries. In this experiment, the social aspects related to individual choices were taken into consideration and socio-economic data of respondents were used, allowing for a segmentation analysis and highlighting socio-economic differences in the air quality acceptability across the various countries.

The results of this analysis suggested that the willingness of citizens to change their behaviour might be larger than previously estimated. In addition, differences in policy acceptability by country and socio-economic structure of the population have been highlighted.

SEFIRA
- ★ Coordinated by the University of Urbino 'Carlo Bo' in Italy.
- ★ Funded under FP7-ENVIRONMENT.
- ★ http://cordis.europa.eu/project/rcn/108791
- ★ Project website: http://www.sefira-project.eu/

"The results of this analysis suggested that the willingness of citizens to change their behaviour might be larger than previously estimated."



AGRICULTURE AND FORESTRY

TURNING MANURE INTO GOLD

Whereas many see manure as just waste, a group of EU-funded researchers see a wasted opportunity to create a sustainable new market for European farmers.

Approximately half the protein we eat comes from animal-based products. To feed our need for meat and dairy products, a considerable amount of manure is produced — about 1.27 billion tonnes from pigs and cows per year to be exact. To put this into perspective, this is enough manure to fill half a million Olympic-sized swimming pools. If not properly managed, this waste is harmful to the local environment and has a substantial impact on climate change.

"The project recovers different nutrients, which can be blended into different green fertilisers based on farmer needs and market demand."

The manure problem is exacerbated by the fact it remains a largely unexploited resource of organic carbon and nutrients. This is because it is not economically feasible to transport manure from regions with a nutrient excess to those with a shortage. As a consequence, Europe's agriculture sector remains heavily dependent on importing 'fresh' nutrients in the form of environmentally harmful synthetic fertilisers.

The EU-funded MANUREECOMINE (Green fertilizer upcycling from manure: Technological, economic and environmental sustainability demonstration) project aims to reverse this by using the resources present in manure in a refined and concentrated manner that also minimises emissions and environmental impact. 'The project intends to demonstrate that a multi-modular technology can be flexibly applied to reduce the environmental impact of intensive animal husbandry in Europe,' says Siegfried Vlaeminck, professor at Ghent University and the University of Antwerp. 'What we propose is a sustainable answer to Europe's nutrient challenge that is commercially appealing, brings value to farmers and enhances Europe's resource autonomy.'

A green circle of manure

To accomplish this, the project created a high-tech installation that recovers 'green' fertilisers from different types of manure. The process starts with a cow or pig creating manure, which is taken up by the MANUREECOMINE installation. The installation then refines various nutrients that can be used to re-blend into a bio-based, custom-made fertiliser. For example, one of the main products recovered is struvite, a precipitate of 'magnesium' (Mg), 'ammonium' (N), and 'phosphate' (P), which can act as a slow-release fertiliser.

Next, instead of turning environmentally harmful substances as fossil fuels and finite minerals into fertiliser, which is the case for making synthetic fertilisers, the project mixes the extracted nutrients with various sustainable additives. The result is a green fertiliser blend. 'The project recovers different nutrients, which can be blended into different green fertilisers based on farmer needs and market demand,' says Nico Boon, professor at Ghent University. 'The green, completely European-made fertiliser is used in the field to grow feed crops, which are later fed to cows and pigs, who then create manure — thus creating a locally closed and completely sustainable cycle.'

A feasible market resource

The MANUREECOMINE project is set to stimulate the market uptake of manure nutrient recovery technology. In fact, according to researchers, the estimated value of fertilisers present in European manure is around EUR 11 billion per year. For comparison purposes, European farmers currently pay EUR 15.5 billion per year for synthetic fertilisers.

According to Vlaeminck, the main beneficiaries of the installation are designers, builders and operators of treatment plants; nutrient trader and fertiliser blending companies; and, primarily, farmers who choose to treat their manure locally. 'Manure is no longer a waste product,' concludes Vlaeminck. 'With MANUREECOMINE, it is a resource that can be commercially mined for added value.'

MANUREECOMINE
★ Coordinated by Ghent University in Belgium.
★ Funded under FP7-ENVIRONMENT.
★ http://cordis.europa.eu/project/rcn/110857
★ Project website: http://www.manureecomine.ugent.be/
★ http://bit.ly/2lM9r5v

BETTER CORKS FOR FINER WINE

A solution for detecting contamination in wine bottling facilities by using a non-invasive sensing device is good news for cork producers, wine bottlers and winemakers.

Using cork stoppers in bottled wine is preferable for both wine producers and consumers. Cork has unique properties which ensure proper sealing of bottles while also offering prime conditions for the ageing process of wine. A major disadvantage of using cork, however, is cork taint. This is a common problem in wine due to haloanisole compounds that can alter wine quality.

Presently, detection of contaminated cork stoppers in the manufacturing plant is the most common solution. Unfortunately, cork stoppers that pass quality controls can still become contaminated at the bottling line. This leads to more economic losses for the entire wine production chain. An EU-funded project, ENCORK (Electronic nose to detect haloanisoles in cork stoppers), has found an alternative solution.

Composed of a core group of European SMEs and prestigious R&D organisations, the team aimed to develop a solution for detecting TCA (the haloanisole most commonly found in wine) in bottling facilities by using a non-invasive sensing device. The device is known as an electronic-nose for the fast detection of TCA at a level of two parts per trillion (2 ng/L). It is able to test 250 corks per hour and can detect TCA at the level of ppt.

The work involved developing the appropriate sensor arrays, software/hardware to process sensor information, a gas-based and mechanical sampling system and an effective prototype at a competitive price. To ensure that cork properties and quality would not be affected, two kinds of stoppers were considered. One was natural cork and the other agglomerated-based cork.

Results were successful and have been disseminated at events and conferences and via the project website. Commercialisation of ENCORK technology can benefit end users and boost sales in the wine industry.

"The device is known as an electronic-nose for the fast detection of TCA at a level of two parts per trillion."

ENCORK
★ Coordinated by Ateknea Solutions in Spain.
★ Funded under FP7-SME.
★ http://cordis.europa.eu/project/rcn/111040

CREATING A BETTER HEMP PLANT

EU researchers are developing new varieties of hemp capable of feeding an innovative hemp bio-refinery and serving as a sustainable alternative to cotton.

Hemp is a sustainable, high-yielding crop that is particularly well adapted for growing in European climates. Not only does it have the potential to bring numerous environmental, agronomical and economic benefits, it can also be used to produce a range of biomaterials that would contribute to the growth of Europe's overall bioeconomy — everything from fibres to seeds and even cosmetics and pharmaceutical products.

With all these advantages, it would seem a no brainer to promote the agricultural production of hemp. Yet surprisingly, in Europe hemp remains a minor crop and the hemp industry struggles to expand its acreage.

'Although hemp was once a key industrial crop for fibre, hemp production disappeared over the last century in favour of cotton and synthetic fibres,' explains Stefano Amaducci, project leader for the EU-funded MULTIHEMP (Multipurpose hemp for industrial bioproducts and biomass) project.

To change this, the project uses a cutting-edge genomic approach to achieve rapid, targeted improvements in hemp productivity and the quality of raw material. At the same time, it is working to advance the scientific understanding of gene-to-trait relationships in the crop. 'By combining this genetic work with innovations in agronomy, harvesting and processing methods, we have generated sustainable products from improved hemp varieties,' adds Amaducci.

A renewed interest

As Europe continues to look for new ways to mitigate the challenges of a changing climate, the need for more sustainable plant-based biomaterials has taken centre stage. For example, although most of our clothes and many other products are made from cotton, the cotton plant itself is an environmental disaster. As cotton fell from grace, a new solution was needed and, according to MULTIHEMP researchers, that solution is hemp.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"We're even analysing the dust produced during the decortication of the stems for possible industrial application."

'There is a renewed interest in hemp because it requires less water and chemicals to grow, and it provides a superior quality of fibre and oil than what can be derived from other plants,' says Amaducci. 'What we are doing is essentially taking an already good crop and turning it into a really great crop.'

Hemp-based bio-refinery

The project's focus is on a natural, bio-refinery hemp plant that can combine the production of superior food (high quality proteins and oil) with a wide array of sustainable bio-materials. New hemp varieties are being developed to feed an innovative hemp bio-refinery where the value of each part of the plant is exploited.

At harvesting, the stem and seeds are separated and the threshing residue is collected to recover valuable secondary metabolites. The stem is then separated, with the short fibre used for producing an innovative flock insulation system and the long fibre for high value bio-composites. 'We're even analysing the dust produced during the decortication of the stems for possible industrial applications,' says Amaducci.

Big benefits

Although still a work in progress (the project is due to end in February 2017), MULTIHEMP's natural bio-refinery hemp plant looks set to produce numerous benefits — both economic and environmental. For example, the project is supporting the release of new varieties suitable for multipurpose applications of the plant. Furthermore, the knowledge generated during agronomic and physiological research will be useful in fine tuning the cultivation techniques and choosing the most appropriate variety for a specific environment and end use.

MULTIHEMP

★ Coordinated by the Catholic University of the Sacred Heart in Italy.
★ Funded under FP7-KBBE.
★ http://cordis.europa.eu/project/rcn/104295
★ Project website: http://multihemp.eu/

INDUSTRY

PLASTIC CHIP DETECTS WATERBORNE VIRUSES

Waterborne viral diseases pose a serious threat to public health around the world. An EU-funded consortium has therefore developed an advanced, reliable nanotechnology-based sensor that can rapidly detect pathogens in water, thereby enabling better monitoring of water quality.

Urban wastewater contains large numbers of human pathogenic viruses, which cannot be completely removed by even the most advanced wastewater treatments. Furthermore, conventional biological water quality indicators are both time consuming and labour intensive, and do not provide adequate information about the presence of pathogenic viruses.

These challenges have been addressed by the project AQUAVIR (Portable automated water analyser for viruses). The consortium, comprising 14 partners from 8 European countries, set out to develop a prototype virus sensor system for monitoring rotavirus, norovirus and hepatitis A virus in various types of water meant for human use.

'The virus monitoring system is intended to detect virus particles in a concentrated water sample on the basis of an electrical readout. Measurement data can then be sent to a monitoring station,' says Dr Noemi Rozlosnik, the coordinator of AQUAVIR. 'The system consists of a "Water sampling and filtering unit" (WSFU) and a "concentration and measuring system" (CMS), which includes a "virus concentration unit" (VCU) and a "virus detection unit" (VDU).'

Water samples are collected by the WSFU and passed through a rough filter to remove particulates and then through glass wool. An elution buffer is then employed to recover the viruses from the glass wool and the collected sample stored for further processing. The VCU meanwhile is used to further increase virus concentration in the liquid sample to improve the limit of detection of the system.

Targeted viruses are accurately detected with the aid of a single-use inexpensive plastic chip. Within the sensor chip several sets of electrodes are exposed to a liquid sample. The electrodes are functionalised with the specific recognition molecules (aptamers), which have a strong affinity for the pathogens they are detecting.

'The recognition molecule, the aptamer, is a short oligonucleotide sequence (single stranded DNA) with a function similar to antibodies, and the detection of the target pathogens is based on electrical measurement. Therefore, it is possible to detect different analytes at the same time on the different electrodes,' Dr Rozlosnik explains.

AQUAVIR results include proof-of-concept for the concentration of virus particles from a water sample using a microfluidic chip and the detection of norovirus in raw water, surface water and wastewater. Additional results involve the mass production of disposable all-plastic chips for detection of pathogens.

Development of an easy-to-use portable multi-sensor using inexpensive chips will help to reduce the costs of monitoring viral pathogens. It will also enable the standardisation of virus contamination levels in water, as quantitative results can be obtained from the electrical readout to provide a routine virus test.

The largest potential market for the AQUAVIR virus detection system is within the water industry. Other end users include environmental inspectorates and water directorates who would benefit from the use of the virus sensor in regular surveillance monitoring as required by the EU Water Framework Directive (WFD).

Moreover, end users can establish databases or complement existing ones on the virological state of water bodies or check raw water resources before and after the use of water treatment technologies. This will be of particular interest to the agro and food industries, breweries and dairies.

AQUAVIR

★ Coordinated by the Technical University of Denmark.

★ Funded under FP7-NMP.

★ http://cordis.europa.eu/project/rcn/110683

★ Project website: http://www.aquavir.eu/

RESEARCHERS AIM TO BRING SMART TEXTILES TO THE MASSES

EU-funded researchers in Germany, Switzerland and Sweden have developed a mass-producible system of sensors that can be embedded in fabrics in order to monitor people's activity and physiological changes.

The three-year SIMPLESKIN (Cheap, textile based whole body sensor sensing system for interaction, physiological monitoring and activity recognition) project has produced washable sensing fabric which can measure body movement, electrical signals, activities and changes in body capacitance and is aiming for the mass market for these smart textiles.

The researchers aimed to take wearable sensing technology from an expensive, niche curiosity to a mass market product, in the same way society has shifted from simple mobile phones to sophisticated smartphones. They see the potential for a number of everyday uses such as analysing muscle activity during exercise or monitoring nutrition.

'We see applications both as wearable and in ambient technology,' says Professor Jingyuan Cheng, SIMPLESKIN project coordinator and a senior researcher at the German Research Center of Artificial Intelligence (DFKI). 'The textile resistive pressure sensors can be produced cheaply as a pressure sensor matrix with up to 10 000 elements and have proven to be attractive for a broad range of applications far beyond wearable systems.'

Several ambient technologies have been trialled successfully, including a smart tablecloth and an intelligent exercise mat that analyses the user's movements through pressure sensors, while several more, such as a pillow that detects people's sleeping posture, are currently under development.

Generic components for mass production

One of the project's core ideas is to delineate the various stages of production of smart technology, such as textile production, electronics development or software implementation.

'Thus, instead of having to implement an expensive special purpose solution for every application, generic mass-producible components could be flexibly put together to create a variety of easily reconfigurable applications,' says Professor Cheng.

The team have come up with an abstraction layer, a kind of 'operating system' (OS) for clothes, which allows people to develop apps for smart garments without requiring them to engage with the complex process of fabric production, electronics or signal processing.

They managed to build a garment OS to run on Google's Android software, allowing developers to use the smart garment in a similar way to a telephone's local sensors.

Interest from industry

The project — carried out by researchers of DFKI, the universities of Boras, Passau and Stuttgart, the Institute of Textile Technology and Process Engineering Denkendorf and the Swiss Federal Institute of Technology in Zurich together with Swiss textile company Sefar — has attracted keen interest from industry.

Car manufacturer Volkswagen has signed a cooperation agreement with DFKI after the institute presented them with the prototype for a smart car seat. This uses pressure sensitive and capacitive sensing fabric to monitor drivers' posture, activity level and breathing rate to alert them when they should take a break.

Sportswear company Adidas is also supporting the development of a smart soccer shoe that measures surface pressure changes when kicking a ball.

Plans for scaling up

The researchers aim to replace conventional clothing with smart alternatives over the next two decades. According to Professor Cheng, the project's technological advances should 'lay the foundation for a high market share for smart textiles as people replace their "dumb" textiles with the large-scale producible smart textile.'

Replacing conventional clothing on a large scale is a complicated business which raises questions on patents, data protections and safety. Thus in the short term, the researchers plan to focus on products for niche markets, such as technology for monitoring health and sports performance.

In the longer term, they aim to develop new methods for textile production to increase flexibility and super large-scale sensing architecture as well as continuing to work with external partners on other applications.

SIMPLESKIN

- Coordinated by the German Research Centre for Artificial Intelligence in Germany.
- Funded under FP7-ICT.
- http://cordis.europa.eu/project/rcn/108514
- Project website: http://simpleskin.org/
- http://bit.ly/2lL6iH8

NEXT-GENERATION CAR MANUFACTURING HAS ALREADY ARRIVED

Innovative low-cost and lightweight aluminium alloys, combined with hot forming technologies, are already beginning to make transport manufacturing much less expensive, greener and significantly more efficient. In a few years' time, the way we make cars worldwide may change completely, with the aviation and electronics industries likely to follow suit.


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As renewable energy, climate change and carbon emissions become urgent priorities for the 21st century, industry is looking at brave new ways to address these challenges. One very promising and recently adopted approach to radically decrease pollution and emissions from transport vehicles is to make cars and even planes out of much lighter alloys. This would significantly reduce the amount of fuel needed and reduce manufacturing costs considerably, making these vehicles greener than ever.

One particular EU-funded initiative that has in fact developed newly patented materials to support this aim was the project LOCOLITE (An industry system enabling the use of a patented materials processing technology for low cost forming of lightweight structures for transportation industries).

Led by a team from the UK's Imperial College London, the project developed low-cost complex-shaped car-panel parts manufacturing technology for high-strength aluminium alloys, using a patented technology called Solution-Heat treatment, cold-die Forming & Quenching (HFQ). 'Compared with the current aluminium body structures for passenger cars that are produced conventionally, manufacturing costs could drop by 30-40 %,' says Professor Jianguo Lin, one of the project partners from Imperial College London. 'In addition, the cost of design for a new car model could be reduced by EUR 25-35 million as many small components can be combined into one.'

The numbers are impressive and speak for themselves: recent studies have shown component weight reduction of up to 55%, depending on the grades of aluminium alloys selected. This in turn results in fuel savings between 20 and 25% and 'carbon dioxide' (CO_2) emission reductions of up to 35%, depending on models and makes. Electric cars also stand to benefit, boasting a higher travel range of up to 35%, which makes them more commercially viable than ever.

Driven by immediate interest from car manufacturers, the technology was adopted by British metal forming specialist, Impression Technologies Ltd, a spin-off company from the patented technology which established the world's first HFQ production line, built by AP&T (Sweden). 'Commercialisation has begun with niche carmakers in Britain — such as Aston Martin and Lotus Cars — to demonstrate the technology's benefits on the ground,' notes Prof. Lin. The next step in the commercialisation process is to manufacture the novel low-cost, low-emission parts for premium cars such as Audi, BMW, Jaguar and Mercedes. 'We're now working to ensure that the technology for these makes will be employed in the next 2-3 years,' says Prof. Lin. He adds that further commercialisation is expected to reach popular cars — i.e. class C and D vehicles — in another 5-7 years.

Apart from the car industry, there has been interest from manufacturers of trucks, busses, trains and aircraft. With respect to vans, buses and trolley busses, fuel savings are expected to reach up to 20%, while the reduction in CO_2 emissions should reach 30%, paving the way for much more environmentally friendly public transport and logistics.

Huge material savings are expected for the aviation sector as well. 'We have successfully formed specific aircraft components which could reduce the manufacturing costs by at least five times compared to current technologies in which 95-97 % of materials are machined away.'

The electronics sector also recently expressed strong interest in HFQ aluminium, especially for electric and electronic device casing such as for mobile phones. 'We expect to see applications in these sectors within the next two years,' says Prof. Lin.

Beyond reduced pollution from vehicles and decreased manufacturing costs, there are also savings that emerge from recycling. 'Aluminium can be recycled easily and it only takes about 5 % of energy to recycle it compared to getting the original aluminium,' notes Prof. Lin. 'If recycled aluminium is used, the material costs could be reduced significantly.' Thanks to HFQ technology, transport manufacturing is on the cusp of a green paradigm shift, with other industries slated to follow soon.

LOCOLITE
- ★ Coordinated by Imperial College of Science, Technology and Medicine in the United Kingdom.
- ★ Funded under FP7-NMP.
- ★ http://cordis.europa.eu/project/rcn/110785
- ★ Project website: http://www.locolite.net/ProjectArea1/home

GRAPHENE MARKET GETS A BOOST FROM NOVEL PRODUCTION METHOD

Whilst there is no denying the potential of graphene, its mass production has so far been hindered by laborious fabrication methods and the high costs they entail. A new technique developed by partners of the CARERAMM project promises to overcome these problems.

The new production method was developed by engineers at the University of Exeter. It consists in creating entire device arrays directly on the copper substrates used for the commercial production of graphene, after which complete and fully-functional devices can be transferred to a substrate of choice.

This process has been demonstrated by producing a flexible and completely transparent graphene oxide-based humidity sensor. Not only does this device outperform currently-available commercial sensors, but it's also cheap and easy to produce using common wafer-scale or roll-to-roll manufacturing techniques.

'The conventional way of producing devices using graphene can be time-consuming, intricate and expensive and involves many process steps including graphene growth, film transfer, lithographic patterning and metal contact deposition,' explains Prof. David Wright from Exeter's Engineering department. 'Our new approach is much simpler and has the very real potential to open up the use of cheap-to-produce graphene devices for a host of important applications from gas and bio-medical sensors to touch-screen displays.'

One of the team's main objectives was to increase the range of surfaces that graphene devices can be put on. Whilst the demonstrated humidity sensor was integrated in a plastic film, other materials such as silicon and textiles can also be considered.

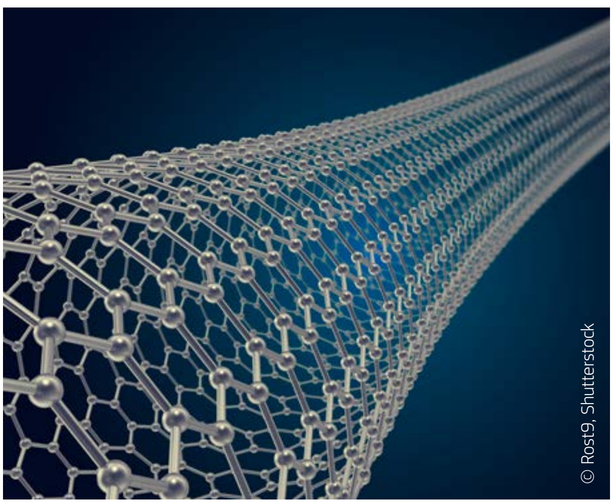
Professor Monica Craciun from Exeter's engineering department and co-author of the paper published in the journal 2D Materials, is confident that this breakthrough will indeed boost the graphene market: 'The University of Exeter is one of the world's leading authorities on graphene, and this new research is just the latest step in our vision to help create a graphene-driven industrial revolution. High-quality, low cost graphene devices are an integral part of making this a reality, and our latest work is a truly significant advance that could unlock graphene's true potential,' she said.

This work was carried out in continuation of the CARERAMM (Carbon resistive random access memory materials) project, which successfully created 'high-performance, cost-effective, environmentally-friendly, resistive-switching type non-volatile data storage' in the form of sp3-rich a-C and 'graphene-oxide' (GO) films earlier this year.

As major companies including the likes of IBM, Intel, Microsoft, Google, Facebook or Amazon will increasingly be looking for 'Storage class memory' (SCM) to improve in memory access latency and bandwidth in big data processing, CARERAMM's technology could provide an appealing solution with high read and write speeds, bit addressability and low energy consumption as carbon memory technology matures.

The CARERAMM project was completed in January 2016 and was funded under FP7 to the tune of EUR 2.6 million.

CARERAMM
- ★ Coordinated by the University of Exeter in the United Kingdom.
- ★ Funded under FP7-NMP.
- ★ http://cordis.europa.eu/project/rcn/106700
- ★ Project website: http://emps.exeter.ac.uk/engineering/research/careramm/



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INFORMATION AND COMMUNICATION TECHNOLOGIES

DEVELOPING TOOLS TO ENHANCE HUMAN MEMORY

The EU-funded RECALL project has been exploring ways of using technology to augment human memory, for instance by feeding data from purpose-built personal memory banks onto screens and other interfaces to replay and remind people of key information from events in the recent or distant past.

Four European universities came together in the three-year RECALL (Enhanced Human Memory) project to research the possibilities of using technology to augment human memory. The project has provided the academic groundwork for producing tools that will benefit society across a wide range of applications.

The researchers, led by Lancaster University's School of Computing and Communications (SCC) in the UK, conducted trials involving almost 1 000 people in campus, workplace and domestic environments, taking care to put ethical considerations first.

Our lives are increasingly recorded

Recent developments in capture technology and information retrieval allow for continuous and automated recordings of many aspects of our everyday lives. Wearable cameras mean many people undertake the regular logging of their activities (sometimes known as 'life logging'). Such material could join other data in building memory banks to draw on for later activities and in older age.

'Technology will soon be able to capture just about everything we do. It's a question of how you can use all that data,' explained SCC's Professor Nigel Davies, RECALL project coordinator. 'We are not so much interested in trying to create a big searchable database, but more allowing you to take the info you've been exposed to, decide what you want to remember, and providing you with cues to help you with subsequent recall.'

Students and elderly people alike can benefit

RECALL focused on giving healthy individuals memory recall beyond their natural capabilities. The project was mainly software-based and assumed a range of data feeds, including life-logging cameras that take photos up to every 30 seconds. The aim was to create software prototypes that extracted the most important data and fed it back to the user later. In total, four trials were conducted, one by each partner.

SCC made available, on displays around the University of Lancaster, highlights of previous lectures to students awaiting their next classes. Researchers at the University of Stuttgart worked with people in their homes, using alarm clock-type devices to send on-line reminders of checks and activities they had to be complete during the day. Those at the University of Lugano in Switzerland recorded business meetings and delivered key information from them as memory cues to help executives in their next meetings. Meanwhile, psychologists at the University of Essex in the UK studied a theory called retrieval induced forgetting, where one event or item is remembered at the expense of another, opening up the potential for manipulation of human memory.

Ethical considerations

The latter example perhaps illustrates why privacy and control of data was such an important part of the RECALL project.

'A lot of the data will be very personal. One of the challenges is how you manage to process it in a way that protects people's privacy. You want to provide the user with full control of all the data captured, who it is shared with and how such digital assets can be disposed of in the future,' Prof. Davies pointed out.

The researchers concluded that sophisticated devices could be developed to help millions of people across Europe whether these consist of memory aids for elderly people suffering from some degree of dementia or learning aids for students and professionals in key sectors such as healthcare and engineering.

RECALL
★ Coordinated by Lancaster University in the United Kingdom.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/110730
★ Project website: http://recall-fet.eu/

A NEW APPROACH TO DIGITAL CONTENT PRESERVATION

When evoking data preservation at the end of its active life, most organisations would think of mere archiving. But should there be more to it? A multidisciplinary team is suggesting a new 'preservation by design' approach, which would see dependencies between the digital object and its environment being be taken into account throughout the former's life cycle.

The increasing digitalisation of content is a two-sided coin. Sure, it enables instant access to a dizzying amount of information. But this comes at a considerable cost: unlike books, digital content is mostly short-lived. The digital ecosystem evolves so fast — with changes in the likes of policies, legal frameworks, professional practices, user expectations and behaviour, or semantics — that long-term access to content cannot always be guaranteed.

This is where the concept of 'preservation by design' advocated by the PERICLES (Promoting and Enhancing Reuse of Information throughout the Content Lifecycle taking account of Evolving Semantics) project comes into play.

'"Preservation by design" means that preservation is not an "afterthought" or an action that comes after the end of the "active life" of a digital object,' says Dr Marc Hedges, senior lecturer at the Department of Digital Humanities at King's College London and coordinator of PERICLES. 'This post-custodial approach implies pro-active and not simply reactive management of digital assets, where preservation is part of the active life of an object.'

Under such an approach, an object is considered 'alive', passing through different phases, or having multiple lives as long as it has not been fully deleted. 'Preservation by design would be part of the data's complete lifetime, from creation to deletion,' Dr Hedges points out.

Beyond technical preservation

Existing approaches to preservation would typically focus solely on the technical environment necessary for long-term archiving. Whilst literature and standards underline that the purpose of such archives is not only technical but also organisational, institutions tend to overemphasise technical aspects.

PERICLES proceeds differently: it investigates how changes to any element of the environment — be it user communities, the institution itself, or the larger social and cultural context — affects the usefulness and interpretation of the digital object, and how such change can be managed.

'A goal of PERICLES was to investigate the hypothesis that, if we can capture the dependencies of a specific object within its ecosystem and implement the resulting models and ontologies into an infrastructural layer, we would be able to analyse the impact of change on the access and reuse of an object and take appropriate mitigating action,' says Dr Hedges.

To this end, the team developed an integration framework and architecture. Its point is to demonstrate workflows and components that would allow for the introduction of a 'change management' layer into existing repository systems. Test-beds were delivered to verify the validity of the approach under different scenarios.

'Components that we could not find on the market, we developed ourselves;' Dr Hedges explains. 'Examples include domain ontologies and ecosystem models, a significant environment information extractor and other tools to populate the ontologies, an entity registry combined with a model repository, a process compiler, an appraisal tool, a policy editor, etc.' Other components can also be considered as long as they fulfil the roles defined by PERICLES' integration framework.

To validate their approach, Dr Hedges and his team needed to use complex data and focused on two domain-ontologies: digital art and media, and space science. 'The institutions managing this data seem to be at opposite extremities in terms of responsibilities. TATE aims to preserve their digital art collections and bring along an exceptional conservation expertise, whilst space operation centre B.USOC represents a sector where preservation is mostly restricted to storage. On the other hand, on "re-use" is not a common concept in art, whilst this notion has grown rapidly within the science domain,' says Dr Hedges.

Among the project's most exciting outcomes, Dr Hedges mentions the understanding that knowledge related to the dependencies of an object and its ecosystem results from

the combination of diverse expertises. Translating that knowledge into semantic models and ontologies, understandable both by humans and by machines, allows for a new form of collaboration between the two.

'This calls for a new alliance between the human professional and the technological system, with the human actor taking on an active role, such as informing the models and making decisions based on the system,' Dr Hedges enthuses. 'We are far away from the vision of technology as a mistrusted friend or the magic wand that does it all on its own.'

Looking ahead

Whilst the research in its current state is still highly experimental, airlines, hospitals, financial and governmental organisations handling various digital assets and wanting to keep them accessible over a long period will certainly be interested in PERICLES research.

In April, the team will be publishing a white paper delineating their approach to other organisations beyond those primarily engaged with preservation, but still facing challenges in this regard.

'In parallel we have been working on creating a portal called PRESERVEWARE — a digital preservation hub — that would help people to find appropriate preservation tools, including those that PERICLES produced,' Dr Hedges explains. 'We looked at existing registries, and, although they are excellent, we believe that the better the field is covered the higher the chance that professionals looking for tools will actually find them.'

PERICLES
★ Coordinated by King's College London in the United Kingdom.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/106905
★ Project website:
http://pericles-project.eu/

HOW MUCH ARE YOU WORTH TO FACEBOOK? A FREE TOOL NOW PROVIDES THE ANSWER

It is a well-known fact that Facebook is more than a social media channel. Each year, the company makes about USD 4 billion in advertising revenues. What people advertising on Facebook did not know until now, however, is how much profit their own activity actually generates.

This question has been bugging researchers at the University of Madrid for a while — enough for them to create an application providing the answer to each individual Facebook user in real time. The tool, dubbed 'Facebook Data Valuation Tool' (FDVT), can be downloaded as a free extension for Google Chrome, and soon enough for Firefox and Opera.

The application is rather easy to use. Once having downloaded it, the user enters some basic identity data including his age, gender, relationship status, interests, country, etc. Once it's done, the tool immediately starts identifying the profile's economic value on the advertising market in real time. The 'real time' part is really important, as Facebook advertising is a volatile sector with highly varying supply and demand.

'Evidently, each of us has a different market price according to our profile, so the tool will give you an estimate of what you are generating,' explain Ángel and Rubén Cuevas, UC3M professors and developers of the new app. 'When you connect to Facebook and receive an ad, what we do is obtaining its associated value, the price that those advertisers pay for displaying those ads or each "click" that you make on one of those ads.' The two researchers notably noticed that the average cost of a user in Spain is roughly half of the cost of a user in the US.

"The team insists that their intention with FDVT was not to demonise Facebook, but rather to push them to report what they do in all transparency."

Among the most interesting facts one will notice when using FDVT is that Facebook continually makes profit, whether you are actually clicking on an ad or not. As Ángel Cuevas notes, 'The advertising sector increasingly "profiles down to the last detail" their potential customers.' Concretely, this means that — based on his web activity and characteristics — a user will receive increasingly personalised ads, so as to improve the advertiser's return on investment. 'There must be "a balance" between this personalisation of advertising (which can be expressly agreed to by users in order to improve their experience) and the guarantee of maintaining basic rights,' Cuevas adds.

The team insists that their intention with FDVT was not to demonise Facebook, but rather to push them to report what they do in all transparency.

The development of FDVT was part of the broader TYPES (Towards transparencY and Privacy in the onlinE advertising businesS) project funded under Horizon 2020. This project, which worries about

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current consequences of opaque advertising practices in the form of ad blockers disrupting the digital economy, aims at defining, implementing, and validating technologies and tools to guarantee privacy and transparency. With these tools, they intend to provide end users with control upon the amount of information they share.

The TYPES project is due for completion in October 2017.

TYPES
★ Coordinated by Eurecat in Spain.
★ Funded under H2020-DS.
★ http://cordis.europa.eu/project/rcn/194867
★ Project website:
http://www.types-project.eu/

HIGH QUALITY, COST-EFFECTIVE VIRTUALISED SERVICES FOR BUSINESSES

Reduced expenditure, easier recovery from potential disasters, more efficient IT operations and better business continuity are so many arguments in favour of virtualised services in enterprise. But two important problems remain that the ENVISAGE project set out to overcome.

Statistics released by Eurostat in 2014 tell us that only 19% of European companies use the Cloud — services directly resulting from the virtualisation of software. This is far less than, say, the US where 82% of enterprises have a hybrid cloud strategy. For partners in the ENVISAGE (Engineering Virtualized Services) project, however, the potential benefits of software virtualisation are worth breaking down the remaining barriers to its wider adoption.

'Virtualised services are business-oriented rather than technology-oriented in their deployment strategy,' says Einar Broch Johnsen, project coordinator for the University of Oslo. 'This means that their deployment on the cloud, as well as their scaling, reflects the business logic of the service and the client-side "Service-level agreements" (SLAs) rather than the provisioning side as supported by the cloud provider.'

With his team, Johnsen believes that two elements are still missing to convince reluctant businesses. The first consists of efficient and dynamic means for the analysis, composition and deployment of services with qualitative and quantitative service levels. The second is a dynamic control of resources such as storage and processing capacities in accordance with the internal policies of the services.

To meet both requirements, the team has developed a practical open-source framework for model-based development of virtualised, resource-aware services. 'Our approach is part of a DevOps [development and operations] methodology,' Johnsen explains. 'Models live together with the software, are extracted from the software and can be made increasingly precise to reflect critical parts of the code while remaining coarse and approximate for less critical parts. This is important as no software today is developed from scratch, so model-based analysis tools should not make that assumption.'

ENVISAGE's semantic foundation for virtualisation and SLA goes beyond state-of-the-art. It uses automated analysis tools to efficiently develop SLA-aware and scalable services able to control their own resource management and renegotiate SLA across the heterogeneous, virtualised computing landscape.

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From mathematical models to concrete applications

Overall, Johnsen says the project's success is on the cards. 'We set out with quite ambitious technical objectives and in the end the project came together in a very nice way, avoiding silos between different research activities. This really made a difference for how the project outcomes integrated with the DevOps approach, delivering a toolbox for automated analysis of resource-aware virtualised services. Using the same model, developers can communicate efficiently with quality assurance and deployment, perform worst-case cost analysis, conduct systematic testing and set up automated SLA monitoring.'

As ENVISAGE focused on studying the foundational semantics of resources and deployment architectures rather than providing a specific technology to market, its framework can be easily adapted to different technology stacks and different levels of abstraction. But the team isn't ruling out the possibility of developing expressive, resource-sensitive models with automated analysis support.

'We are actually exploring different application domains for the framework now and several of the project partners are discussing concrete applications in different sectors. One of our plans is to use the ENVISAGE framework to support a collaborative control panel for DevOps teams,' says Johnsen. In addition to services and cloud, other sectors of interest for the consortium include logistics and transport.

Overall, ENVISAGE provides companies creating virtualised services with the means to ensure that their development, operation and quality assurance teams collaborate more effectively in an agile DevOps process, all whilst ensuring that deployment strategies better reflect the business-logic of the company.

'Use cases from the ENVISAGE project suggest that the gain in efficiency from this kind of approach not only increases the quality of the services but it can also be a significant cost saver in terms by reducing the size of the DevOps team,' Johnsen concludes.

ENVISAGE
★ Coordinated by the University of Oslo in Norway.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/109999
★ Project website: http://www.envisage-project.eu/

"Unlike the Milky Way, massive galaxies grow in a way that is fundamentally different."

SPACE

NEW INSIGHT INTO GALAXY AND STAR FORMATIONS

Understanding the formation and evolution of galaxies is one of the biggest questions in astronomy and spans many years of research. An EU-funded team sought to shed new light on the topic by studying populations of stars in different galaxies and extracting information about their age and the elements they contain.

Much of the research currently performed on galaxy evolution is based on the astronomy project Calar Alto Legacy Integral Field Area's (CALIFA) survey which is imaging a sample of about 600 galaxies in the universe. Combining imaging and spectroscopy, the data taken help derive useful information on galactic structure as well as the physical properties of galaxies such as their kinematics, mass, chemical composition and age. Data analysis is not based on treating distant galaxies as a single entity or single stars.

Questions about the age of the elder star populations in each galaxy and their mass fraction as well as the chemical enrichment history of each galaxy are always topical and were the main subject of research in the EU-funded project SFEHG (The star formation and enrichment histories of galaxies).

The team demonstrated that valuable information about subpopulations of stars in distant galaxies can be obtained through integral field spectroscopy that the CALIFA survey uses. Comparisons revealed that, unlike the Milky Way, massive galaxies grow in a way that is fundamentally different. In our galaxy, giant molecular clouds provide the reservoir of raw materials from which stars are born. However, star formation in massive galaxies is not intertwined with the stars that existed before them; stars stem from the merging of smaller, independent galaxies into a massive galaxy.

Expanding on these findings, and based on data on determined ages and chemical abundance in certain massive galaxies, scientists succeeded in determining in what timescale supernova explosions occur after the creation of a new stellar population.

Several activities were conducted to disseminate project findings. In addition, the team published an image depicting maps of some of the properties of galaxies obtained from CALIFA.

SFEHG

★ Coordinated by Leibniz Institute for Astrophysics Potsdam in Germany.

★ Funded under FP7-PEOPLE.

★ http://cordis.europa.eu/project/rcn/102683

IN SEARCH OF THE ORIGIN OF DARK MATTER

With an advanced particle detector mounted on the exterior of the International Space Station (ISS), EU-funded scientists and their colleagues have gathered measurements to learn more about the origin of dark matter.

The detector, named Alpha Magnetic Spectrometer (AMS-02), captures cosmic rays coming from throughout our galaxy. Galactic cosmic rays are particles accelerated by the explosions of supernovae — stars with a mass many times larger than our Sun that collapse violently towards the end of their life.

Among the cosmic rays entering AMS-02, there are positrons. These stable antiparticles of electrons provide valuable insight into the characteristics of primordial dark matter. EU-funded scientists based at the Middle East Technical University in Turkey were heavily involved in the AMS-02 data analysis.

"The AMS-02 data showed unambiguously that there is an active source of positrons in our galaxy."

Within the project DARKMATTERAMS (Search for a dark matter signature with the Alpha Magnetic Spectrometer (AMS-02) experiment), they contributed to the main scientific results from AMS-02 observations as well as a series of publications in high-impact peer-reviewed journals.

The AMS-02 data showed unambiguously that there is an active source of positrons in our galaxy. Scientists do not know if these positrons are coming from dark matter collisions or another source. But, measurements are still underway that may discriminate between the two hypotheses.

To date, AMS-02 data collected are sent almost in real time together with the rest of the ISS data to the Marshall Space Flight Center (MSFC) in Alabama, United States. The bulk of the data is then redirected to the Payload Operations Control Centre (POCC) at the European Organisation for Nuclear Research (CERN) in Switzerland.

The DARKMATTERAMS team runs shifts at POCC while analysing AMS-02 measurements. While studying the positron fraction versus energy, scientists found an excess of positrons at lower energies than anticipated, suggesting a source other than cosmic rays.

The positron fraction peaked at an energy of hundreds of 'Giga-electron-volts' (GeV), which indicates that the observations could be compatible with a dark matter source of positrons such as dark matter collisions. The result is exciting. A solid scientific explanation is expected to come with further experimentation.

DARKMATTERAMS
- Coordinated by the Middle East Technical University in Turkey.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/project/rcn/102625

A NEW WINDOW ON THE UNIVERSE

Do astronomical objects such as black holes and neutron stars have the wavy behaviour predicted by general relativity? Interestingly, an advanced laser interferometer gravitational-wave detector may provide the answer to this fundamental question.

Albert Einstein predicted the existence of gravitational waves more than a century ago. In 2015, physicists working with the Laser Interferometer Gravitational-wave Observatory (LIGO), a pair of gigantic instruments in Hanford, Washington and Livingston, Louisiana in the United States, detected these ripples in space-time for the first time.

This discovery required a history of hunting and, more important, enormous technological progress. To expand the reach of gravitational-wave detectors, EU-funded scientists have explored different approaches promising to overcome quantum mechanical limits.

The EAGLE (Exploring quantum aspects of gravitational wave detectors) project was devoted to a systematic study of these approaches considering their complexity and sensitivity improvement. The aim was to offer guidelines for enhancing the performance of future gravitational-wave detectors.

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Gravitational-wave detectors, including LIGO, use high-power lasers and kilogram-scale mirrors as test masses, separated by kilometres. To detect weak gravitational waves from the distant universe, they have to be extremely sensitive to the tiniest displacement of the test mass. Noise of quantum origin starts to limit their sensitivity.

Scientists explored different approaches to reducing quantum noise and enhancing the detector response to gravitational-wave signals. One novel approach considered in EAGLE is placing an optomechanical device serving as an unstable filter inside the signal-recycling cavity, which compensates for the propagation phase lag (positive dispersion) of the signal. This new scheme can enhance the detector bandwidth, while at the same time the peak sensitivity could be maintained when focusing on the noise level.

Using numerical modelling and analytical studies, EAGLE's work has led to new ideas for designing the next-generation gravitational-wave detectors. These are ideal instruments for probing the universe, and therefore revealing astrophysical phenomena that have not been observable with the detection of cosmic light.

EAGLE
- Coordinated by the University of Birmingham in the United Kingdom.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/project/rcn/186659
- Project website: http://icc.dur.ac.uk/Eagle/

FUNDAMENTAL RESEARCH

SCANNING SKYRMIONS UNCONVENTIONALLY

EU-funded researchers have used 'Spin polarised scanning tunnelling microscopy' (SP-STM) in combination with magnetic resonance to study and measure magnetic vortex gyration and skyrmionic states.

Researchers contributing to the ATOMS (Advanced tools to observe magnetic and dynamical properties of skyrmions and vortices down to the atomic scale) project developed a new technique for measuring magnetisation dynamics down to the atomic scale. Using SP-STM in combination with magnetic resonance allowed the scientists to probe high-frequency magnetisation dynamics, which conventional STM methods fail to accomplish due to bandwidth limitations.

The technique involved a continuous 'radio frequency' (RF) voltage mixed with the bias voltage of the STM via a dedicated transmission line. In the case of a magnetisation precession under the SP-STM tip, the tunnelling conductance was modulated at the precession frequency. Afterwards, the tunnelling current, corresponding to a ferromagnetic resonance signal, was rectified and measured using conventional tools. To keep the signal amplitude stable, despite the frequency-dependent cable effects, the scientists had to know the setup in detail and pre-adjust it. As a result, the bandwidth of the STM was increased up to 3 GHz.

This method was first used to examine magnetic vortex gyration, a system with well-known properties and in the accessible frequency range. The simulation studies showed that the RF current needed was accessible only under extreme tunnelling conditions, leading to unstable experiments.

Consequently, the scientists working on ATOMS decided to analyse the gyration mode of magnetic skyrmions. Compared with magnetic vortices, the RF current required to excite skyrmion states is very low, resulting in manageable experiments.

Two spin structures were selected: iron monolayer on iridium (111) (Fe (1 ML)/Ir(111)) and cobalt monolayer on ruthenium (001) (Co (1 ML)/Ru(0001)). The investigation of Fe (1 ML)/Ir(111) revealed a resonance signal of 615 MHz.

In addition, the study of Co (1 ML)/Ru(0001) at zero magnetic field demonstrated a chiral spin spiral as a ground state. This constitutes the first experimental observation of a chiral non-collinear spin structure stabilised at an interface between a 4d metal and a 3d ferromagnetic element. For both cases, theoretical work continued after the project ended.

Skyrmions play a key role in future applications such as magnetic storage and RF devices, while skyrmion-based spin transfer nano-oscillators have already been proposed. In light of these developments in technology, the final results of this project are expected to contribute significantly to the field.

ATOMS

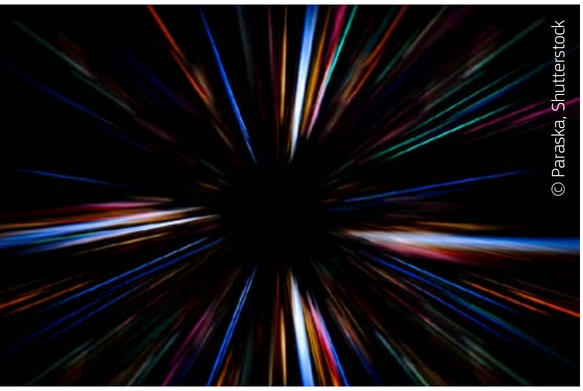
★ Coordinated by Karlsruhe Institute of Technology in Germany.

★ Funded under FP7-PEOPLE.

★ http://cordis.europa.eu/project/rcn/187692

MOVING ELECTRONS CAPTURED BY BRIGHT ULTRAVIOLET LIGHT

EU-funded scientists have demonstrated, for the first time, the generation of isolated attosecond pulses of unprecedented brightness in the extreme ultraviolet window. This achievement allows scientists to further explore ultrafast physics such as electron dynamics and quantum tunnelling.



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To catch a glimpse of something as small and fast as an electron moving within atoms, molecules or solids, you need a bright light with ultrashort pulses that extend to the attosecond timescale. To create this form of light, scientists have over the last few years been using intense laser pulses to illuminate a cloud of weakly ionised gas. Known as 'High-harmonic generation' (HHG), this process shifts laser light wavelengths to shorter wavelengths and generates pulses with attosecond durations.

In the EU-funded project ALPINE (Attosecond source from laser-plasma interaction), scientists succeeded for the first time in inducing HHG in plasma mirror targets by illuminating them with a two-cycle laser pulse. When intense laser pulses hit optically-polished surfaces, they produce dense plasma that acts as a mirror. This laser-plasma interaction leads to the generation of attosecond bursts of extreme ultraviolet light that are shorter and brighter.

Scientists' work led to the first experimental demonstration of HHG in the relativistic limit — at intensities above a certain limit, laser light accelerates target electrons almost to the speed of light.

To reach this goal, ALPINE made many improvements to the existing laser system to obtain excellent temporal contrast. The pedestal was reduced by many orders of magnitude by combining a cross-polarised wave temporal filter and a plasma mirror. Control of the dispersion of the laser system led to the elimination of parasitic prepulses.

An important observation that points to the fact that relativistic high harmonics leads to the generation of attosecond laser pulses was that HHG depends on the carrier-envelope phase of the laser pulse.

ALPINE showed that HHG is a prerequisite of attophysics; its novelty was that it illuminated the target with two-cycle laser pulses rather than traditional multiple-cycle laser sources to generate attosecond pulses. Project achievements should allow for further probing of ultrafast electron dynamics in matter.

ALPINE
★ Coordinated by Max Planck Institute in Germany.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/188115

ORGANIC CHEMICAL PRODUCTION MADE GREENER

Researchers have made organic chemistry greener by developing ways to use inexpensive, non-toxic and naturally abundant elements as catalysts and reagents to produce organic products.

Chemical products are made when substances known as reactants are changed to other substances by breaking and forming chemical bonds. These bonds are created either when atoms within molecules share electrons or when atoms with opposite charges are attracted to each other.

The process of chemically transforming reactants to products is often inefficient and generates a large amount of hazardous waste. The EU-funded HYPERCAT (Hypervalent chemistry and catalysis) initiative worked to develop more environmentally friendly ways to make organic chemical products — in particular, complex small molecules.

One way to make reactions more efficient is to use a catalyst, which helps to break and form bonds by both receiving and donating electrons. To create carbon bonds in organic molecules, chemists often use expensive metals like palladium, nickel or platinum as organometallic catalysts.

HYPERCAT looked at whether the non-toxic, naturally abundant elements boron and silicon could be used in place of traditional organometallic catalysts to make organic compounds. Under specific conditions, boron and silicon are useful electron carriers. To develop a bigger repertoire of non-toxic organometallic reagents for organic chemists to use, researchers sought to understand how they behave under these conditions.

Team members then developed ways to make boron- and silicon-based reagents with specifically designed chemical structures. These reagents can be used to make complex molecules with structures that are difficult to create by other methods.

"To develop a bigger repertoire of non-toxic organometallic reagents for organic chemists to use, researchers sought to understand how they behave under these conditions."

The organic molecules that HYPERCAT created in this way, called alkenes, are among the most important and widely used industrial compounds globally. By providing inexpensive, environmentally friendly chemical pathways to produce these and other organic molecules, HYPERCAT has made an important contribution to green chemistry.

HYPERCAT
★ Coordinated by the University of Madrid in Spain.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/102823

EVENTS

APRIL
03▸04

Brussels, BELGIUM

CONFERENCE

FIRST EUROPEAN CONFERENCE ON CONNECTED AND AUTOMATED DRIVING

The European Commission, with the support of the EU-funded projects CARTRE and SCOUT, will be hosting its First European Conference on Connected and Automated Driving in Brussels, Belgium, from 3 to 4 April 2017.

The high-level conference 'Connected and Automated Driving – Together, shaping the future' will provide a unique opportunity for all participants to network and discuss on how to boost the development and deployment of connected and automated driving technologies from a fourfold perspective: transport policy issues; technological challenges; legal and regulatory frame, and digital transformation.

Major road transport stakeholders are invited to attend this event that will see EU leaders, CEOs and representatives from major road transport stakeholders discuss interactively on the role of R&I and policy making to accelerate roll out in Europe; what's going on in the Member States; the role of connectivity between vehicles, road infrastructure and other road users to enhance performance, etc.

For further information, please visit:
http://connectedautomateddriving.eu/

APRIL
05▸07

Delft, NETHERLANDS

CONSORTIUM

RISC-KIT CONSORTIUM FINAL CONFERENCE

The RISC-KIT Consortium will host a special final conference event to mark the end of the project to discuss the latest developments in the area of coastal storm preparedness and disaster risk reduction.

The RISC-KIT Consortium will host a special conference event to mark the end of the RISC-KIT project. The conference will bring together researchers from the RISC-KIT project and others, to discuss the latest developments in the area of coastal storm preparedness and disaster risk reduction.

The main objective of the RISC-KIT project was to develop methods, tools and management approaches to reduce risk and increase resilience to low-frequency, high-impact hydro-meteorological events in the coastal zone. These products would enhance forecasting, prediction and early warning capabilities, improve the assessment of long-term coastal risk and optimise the mix of prevention, mitigation and preparedness measures.

The conference is scheduled to take place in Delft, Netherlands, from 5 to 7 April 2017.

For further information, please visit:
http://www.risckit.eu/np4/381.html

APRIL
24

Brussels, BELGIUM

EVENT

EQUIP SHOWCASING EVENT

The EU-funded EQUIP project will be holding its Showcasing Event in Brussels, Belgium, which takes place on 24 April 2017.

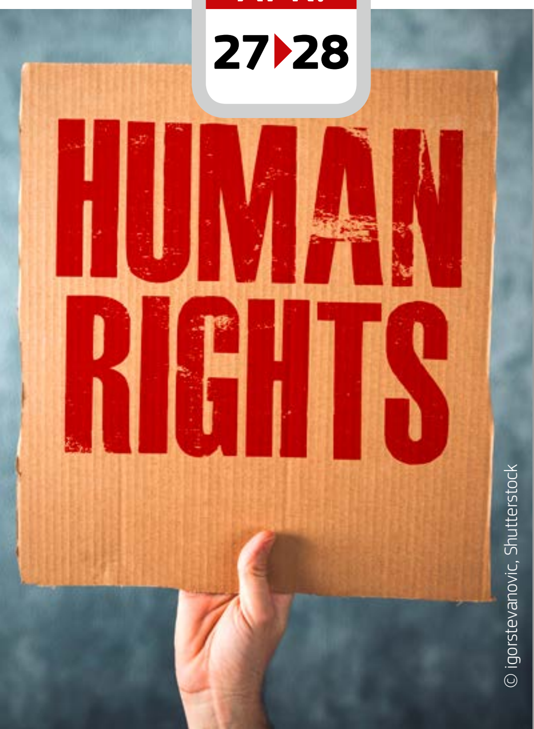
High level policy and research stakeholders will discuss the potential impact of closer coordination between Europe and India in the area of Social Sciences and Humanities for research and policy innovation.

The EU-India Platform for Social Science and Humanities is the first research collaboration platform between India and the EU specifically dedicated to Social Science and Humanities. 16 social science and humanities funding and support organisations in Europe and India work together to develop a stronger strategic partnership for multi-lateral research collaboration.

For further information, please visit:
http://equipproject.eu/

EVENTS
For more forthcoming events:
http://cordis.europa.eu/events

APR.
27▸28



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Leuven, BELGIUM

CONFERENCE

2017 AHRI CONFERENCE

The EU-funded FRAME project is helping to organise and host the 2017 edition of the Association of Human Rights Institutes (AHRI) Conference and will take place in Leuven, Belgium, from 27 to 28 April 2017.

The AHRI conference gathers member institutions together to coordinate and plan their research through working group seminars and to discuss current issues in defined research areas. The AHRI conference is held annually, and the conference is hosted by a different institution every year. The Annual Assembly meeting is also held during the conference.

In 2017, the conference, entitled 'The Promotion and Enforcement of Human Rights by International and Regional Organizations' will be hosted by the Leuven Centre for Global Governance Studies, part of the University of Leuven, which is coordinating the FRAME project. FRAME focuses on the contribution of the EU's internal and external policies to the promotion of human rights worldwide.

For further information, please visit:
http://www.fp7-frame.eu/event/ahri-2017/

ZZ-AC-17-002-EN-N

The digital transformation of government will benefit citizens and businesses, save administrations money and create a new marketplace for public service applications.

Through its Horizon 2020 programme and Competitiveness and Innovation Framework Programmes (CIP), the European Commission has sought to overcome obstacles to rolling out e-Government applications, and also provide the tools for administrations to deliver new cloud-based services across departments and across borders.

This Results Pack showcases the results of seven EU-funded projects, and examines exactly how public services and citizens stand to benefit. The Pack also outlines how new commercial opportunities will be opened up through the creation of a vibrant e-Government application marketplace.

Please see the following link for more information: http://cordis.europa.eu/article/id/400182

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