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RESULTS MAGAZINE

N°44
JULY 2015

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research*eu
RESULTS MAGAZINE

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Melinda KURZNE OPOCZKY

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EDITORIAL

by the editorial team

SEEKING THE BALANCE BETWEEN SECURITY AND PRIVACY

With recent events such as revelations surrounding the NSA's data surveillance programme and terrorist attacks in France, Belgium and Denmark, security has never been so high on the EU political agenda. Data published by Eurostat in 2015 reveals that, while most Europeans feel safe, concern over most known security threats has grown between 2011 and 2015. What hasn't changed, however, is the complexity of the underlying challenge: higher security levels are often synonymous with less freedom and privacy, and implementing appropriate measures implies finding a subtle balance between both priorities.

On the one hand, one of the EU's key roles is to identify security threats and address them in a way that provides for a 'secure Europe in a better world'. These threats include terrorism, of course, but also organised crime and cyber security. However the EU has to do this while remaining true to its core principles and values of free movement of people and goods, human rights and respect for citizen privacy.

To strike this balance, the EU needs further investment in R&D and new approaches to security. These can include, for example, policy recommendations or new technologies to counter the security threats of the 21st century. And with only half of Eurostat responders believing that new technologies can help increase security and a quarter of them thinking these may actually have negative implications, researchers will be challenged to convince them otherwise.

'Some EUR 1.4 billion have been dedicated to security under FP7.'

At the EU level, these efforts are backed by EUR 1.4 billion under the FP7-SECURITY programme. The objective for the European Commission: developing the technologies and knowledge needed to ensure the security of citizens while respecting fundamental human rights; ensuring optimal and concerted use of available and evolving technologies; and stimulating industry and user cooperation while improving the competitiveness of the European security industry.

This edition of the *research*eu results magazine* highlights the contribution of 13 FP7 projects to meeting these objectives. These highlights include four interviews illustrating the vast range of issues our scientists are working on, from more secured cloud computing technology to 3D acquisition of crime scene evidence and systems protecting European railways from electromagnetic attacks.

This 'special feature' section is followed by our usual insights into biology and medicine, social sciences and humanities, energy and transport, the environment, IT and telecommunications, industrial technologies and space, along with a list of upcoming scientific events.

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

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Focus on
Going full circle with our wastewaters

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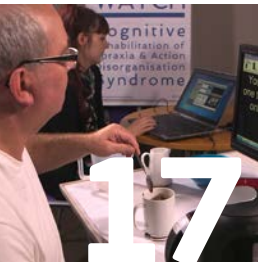

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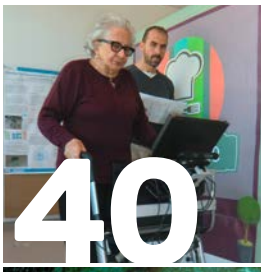

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WHERE SCIENCE MEETS SECURITY

INTERVIEW

PAVING THE PATH FROM INCREASED TRUST TO MORE POWERFUL CLOUD APPLICATIONS

For cloud computing to achieve its full market potential, the next logical step in its evolution would be a switch from storage to remote processing of data. This requires a high level of trust among stakeholders, which is what the TRESCCA project aims to achieve.

Although the cloud is undoubtedly making our life easier, a world where you can use it with no fear of security issues still looks unlikely. Recent security breaches in some of the most popular storage services (remember 'Celebgate'?) have reinforced the idea among end users that sensitive data should stay far away from the cloud. And while cryptography is an efficient way to get around the problem for cloud storage, its use is incompatible with remote processing of the stored data.

This poses a major problem: by 2016, over a quarter of all applications are predicted to be available on the cloud. Not only is the resort to cryptography slowing down this evolution, but service providers can also find it hard to trust and allow computation of data stored on their servers by their clients — thereby hindering innovation in the sector.

To resolve this issue, TRESCCA (TRustworthy Embedded systems for Secure Cloud Computing Applications) aims to propose and demonstrate innovative hardware security and virtualisation techniques for the cloud. These would allow stakeholders to delegate the processing of sensitive data to a remote processing engine while avoiding a shift in paradigm, as they will complement existing legacy solutions with non-intrusive add-ons instead of replacing them.

Andreas Herrolz, coordinator of the TRESSCA project, explains how the consortium's work will help build the long-awaited trust between cloud users and service providers, thereby opening the door to a whole new field of services and applications.

★ **EU citizens are increasingly relying on cloud computing applications. Can they feel safe doing so?**

Andreas Herrolz: In general cloud services have become more reliable and secure over the last years. Nowadays they provide a high level of comfort and convenience and are particularly useful in the context of mobile and cross-device applications. Cloud service providers have learned from previous mistakes and generally improved the level of data protection and security of their services. However, there is still a significant risk involved when storing any kind of private and sensitive data in the cloud. Events like the Snowden revelations and recent hacking attacks on popular cloud services and companies have shown that even if service providers are assuring

their users of a high level of security, end users cannot fully trust them.

★ Would you say that the cloud market is currently hindered by this lack of trust between providers and users?

Yes, definitely. The cloud has a very high potential to significantly change the way we use computers and mobile devices. It is also the backbone of future concepts like Smart Cities and the Internet of Things. However, as long as we cannot guarantee and verify a high level of security and protection for the data that is stored and processed on remote servers, these kinds of applications cannot be realised without making compromises.

★ What kind of techniques does TRESCCA use to create a more secure and trusted cloud?

TRESCCA is developing hardware and software components that help to create a safe and secure execution environment for any kind of computing applications. On the hardware level, TRESCCA is developing security components that are integrated into so-called system-on-chips. Such chips are already commonly used in computers, smartphones, tablets and set-top boxes. The TRESCCA security components, called 'Hardware security modules' (HSM) protect the communication inside and outside of the chip. For example, any attempt to modify or read data stored inside the RAM of a computer would be detected and prevented. On top of that, TRESCCA creates a secure software execution environment using virtualisation technology to isolate applications in small light-weight virtual machines. These virtual machines can also be used to securely move trusted applications between devices. The combination of HW and SW technology provides a level of security that can be verified remotely by service providers and users.

For demonstration purposes, TRESCCA is integrating these technologies into cloud-connected client devices, such as smart meters and set-top boxes. By providing trusted and verifiable execution environments, certain parts of the application and its corresponding data do not have to be moved to the cloud but can instead be executed locally. In the future, the same technology might also be integrated into cloud servers, enabling end users to assess and verify the security of the servers remotely before moving their data into the cloud.


© Andreas Herrolz

ANDREAS HERROLZ

★ You claim that your system will enable new cloud services and applications. Can you explain?

Currently, any sensitive data needs to be encrypted on client-side before it is stored in the cloud in order to be secure. However, this also prevents any kind of meaningful computation on that data in the cloud. On the other hand, if end user devices, like PCs or smartphones, are not trustworthy, any kind of local computation done by these devices will not be trusted by service providers. So we end up in kind of a dead-lock situation for any cloud application that requires service providers to access and process private data which itself is too sensitive to be stored in the cloud. With TRESCCA, such applications are possible, with trustworthy end-user devices processing sensitive data locally. Then only the results need to be transmitted to the service provider. In general, this may introduce a paradigm shift on how cloud services are designed today, reduce data-monopolies of providers and lead to more decentralised architectures.

★ TRESSCA solutions will also be made available for free. Why did you choose to do this?

So far, most existing hardware security solutions are proprietary and either available under commercial license or not at all. However, we think that this limits adoption, and security solutions will only be accepted and deployed on a wide scale if they can be used, assessed and integrated into products by everyone without any restrictions. Also we would like to cooperate with other companies and researchers for further improvement of our solutions and we think that a free access model supports this vision. Nevertheless, there are still several options for TRESCCA partners to exploit its results commercially, for example by making end-user products based on TRESCCA technology or by offering development services to other companies.

★ When can we expect your technology to reach the market?

For the hardware solutions it could still take several years, since development of new system-on-chips is very costly and takes a lot of time, in particular if new components are being integrated for the first time. However, the software solutions delivered by TRESCCA are not dependent on these components and may already be used with existing hardware. So they may reach the market much earlier, within one or two years.

★ The project is close to completion. What's the industry feedback so far?

Actually, there is very high interest in free and open hardware security solutions from industry. This includes semiconductor companies, device manufacturers as well as cloud solution providers. With cloud applications extended towards mobile and industrial applications, having reliable security solutions in place becomes more critical or even essential for commercial success. The solutions offered by TRESCCA and its open access model are very attractive for companies. However I think we can still improve how we explain what exactly is available from TRESCCA and how it can be used to create secure HW/SW applications. In the end, TRESCCA is only one part of the solution and, as with all security concepts, it has to be combined with others and used in the right way to be fully effective.

TRESCCA

- ★ Coordinated by OFFIS in Germany.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/105138_en.html
- ★ Project website: http://www.trescca.eu/
- ★ http://bit.ly/1GrsjOv

A TACTICAL APPROACH TO COUNTERTERRORISM

The EU is working to develop a more capable and efficient strategy for combating terrorism as threats rise in urban areas. The TACTICS system — including tools for threat and capability management and threat decomposition — will support this effort by enhancing counterterrorism efforts at the local, national and regional levels.

Terrorist attacks in urban centres — such as those in New York, London, Madrid and Boston — have intensified the focus on counter-terrorism efforts in recent years. Urban hubs are specifically targeted due to their high population density and cultural significance, and this poses an enormous challenge for security forces. The EU-backed TACTICS (Tactical approach to counter terrorists in cities) project team has been working for almost three years now to address these issues through a dedicated system that helps enhance security and mitigate the consequences of terrorism, and improve techniques for recognising the signs of attacks and quickly assessing responsive capabilities.

"The Threat Management Tool will allow the Threat Manager and his/her team to gain a common picture of the operation and increase their situation awareness during the 'threat facing' and 'neutralisation' tasks."

The TACTICS system separates the analysis of the threat into three parts and identifies three specific profiles to manage each aspect: 'threat manager' (TM), 'Threat decomposition manager' (TDM) and 'capabilities manager' (CM). TACTICS envisions these team leaders working in units using the TACTICS tools — including the 'Threat management tool' (TMT), the fusion unit module, and the 'Threat decomposition tool' (TDT), and the 'Capability management tool' (CMT) — as well as TACTICS strategies to identify and manage threats.

How will it work in practice? Taking the TMT as an example, it will gather information in the field from all of the other tools, allowing the Threat Manager and his/her team to gain a common picture of the operation and increase their situation awareness during the 'threat facing' and 'neutralisation' tasks. Apart from offering an up-to-the-minute overview of the situation — including 3D view of the environment and access to Open Data information from public agencies' traffic control cameras, etc. — the TMT will allow the threat management team to communicate with other teams. It will also be available on mobile phones so it can be used by units deployed in the field.

As part of developing these tools, TACTICS held an end user workshop where possible attack scenarios were discussed and operations were simulated. The results of this workshop, combined with an analysis of historical attacks in a structured, non-biased way, were used to refine and improve the system.

The project concludes at the end of August, however the team presented the final results at IFSEC, an international security conference held in London from 16 to 18 June.

TACTICS

- Coordinated by the Netherlands Organisation for Applied Scientific Research in the Netherlands.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/156597_en.html
- Project website: http://www.fp7-tactics.eu/index.html

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INTERVIEW

NEW DETECTION SENSORS CAN HELP RAILWAYS COPE WITH EM ATTACKS

Eleven years ago the Madrid train bombings proved how much European railway security still needed to be improved. But now that rail equipment — like in most other industries — is increasingly standardised and connected, another, more insidious type of offensive has become likely: 'electromagnetic' (EM) attacks. An EU-funded project has developed detection technologies that can help the sector face this new threat.

Did you know that soon, there will be as many connected devices as there are humans on Earth? Five billion of these devices are now in use and this number is expected to reach 25 billion in 2020. Sure, each new type of connected device brings us closer to the advent of smart cities and all of their foreseen benefits. But on the other hand, as recent news has shown, it makes hackers and other tech enthusiasts with bad intentions a growing threat to security.

In the European railway sector for instance, the homogenisation of network technologies and the increasing use of wireless communications has made the scenario of an EM attack very likely. Communication jammers are easy to use and available for anyone to purchase on the Internet, which means that communications could potentially be jammed, with trains being delayed, blocked or even diverted.

To get the sector ready to face this new threat, the SECRET (SECurity of Railways against Electromagnetic aTtacks) project has developed a set of detection sensors capable of identifying EM attacks as they occur, so that rail equipment operators can switch the network to a 'safe mode' immune to the specific type of EM attack being used.

Virginie Deniau, coordinator of SECRET, discusses the likelihood of the EM attack scenario, the devices developed by her team and how the sector will soon need to adapt to this new reality.

★ How likely would you say is the EM attack scenario?

Virginie Deniau: The definition of an EM attack evolves with the multitude of the applications based on wireless communication technologies. In the past, the EM attacks were based on the generation of high power intentional interferences (Electromagnetic pulse or high-power microwaves) able to disrupt or damage electronic equipment. Today, the functions of this equipment can be triggered by a command or information transmitted by wireless links, which means it is now easier to disrupt the transmitted information without damaging the equipment. Such attacks require a less powerful signal which can be generated by mobiles and other discrete devices.

So, from a technological point of view, the likelihood of an attack increases with the vulnerability of the infrastructures. However it is difficult to establish a clear probability because today it is impossible to distinguish a technical failure from an EM attack. EM attacks based on relatively 'low' power signal involve disruptions but no permanent damage.

© Virginie Deniau

VIRGINIE DENIAU

★ You mentioned mobile devices. Does that mean anyone is virtually capable of conducting such attacks?

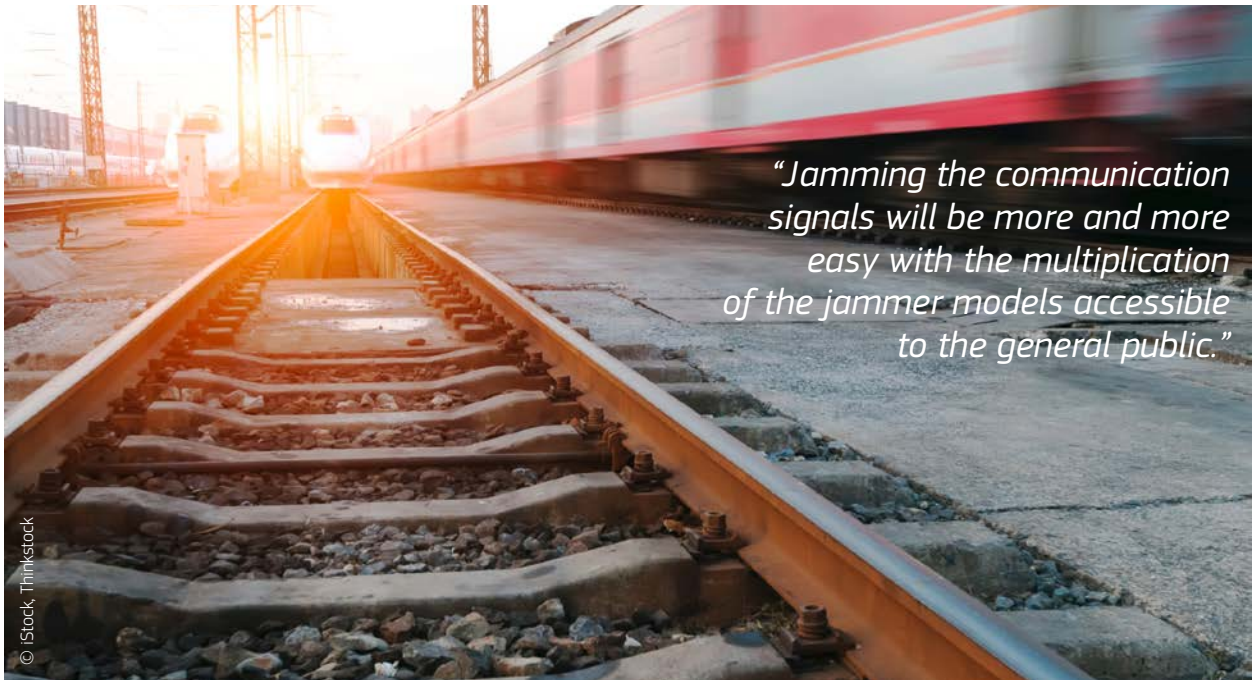
The knowledge of the target is essential to define the means needed to perform an EM attack. Nowadays public communication jammers can easily be bought on the public market but their power and action are limited.

Now if we consider professional or security communication services, specific devices are generally required for such attacks. These devices are usually restricted to the professional market or have to be developed from scratch. While possible, this requires a certain level of skill and knowledge.

However, when these professional applications are supported by public wireless services, they can be disrupted by common jammers. So there is a real issue coming up, and the security and criticality of wireless services have to be seriously considered.

★ SECRET focuses on railway security. What could be the consequences of EM attacks in this sector?

The main direct risk is a perturbation of rail network traffic. It may be possible to prevent the departure of trains, force train stops and cause significant financial losses and unmanageable situations. However, it is difficult



to accurately assess cascading risks, as they depend on the characteristics of each railway network (exploitation, infrastructure, applications, etc.).

★ Can you tell us more about the tools you developed?

SECRET's vision is that if we are able to detect an EM attack with certainty, we can imagine switching to a safe railway mode perfectly adapted to the situation and allowing operators to regain control. The challenge is therefore to develop fast and reliable detection solutions. With this in mind several solutions have been studied under SECRET. Some could be implemented directly within the communication terminals and others would require dedicated devices but offer the advantage of being able to monitor multiple communication links.

In order to reach resilience, our detection sensors were coupled with an acquisition and decision terminal which was charged with analysing the output of these detection sensors and commanding a reconfigurable telecommunication platform. According to sensors' output, the decision terminal directs the messages to be transmitted towards the communication link that's most resilient to the EM attack. Obviously, such an approach requires the deployment of several communication networks.

★ When do you expect SECRET's technology to reach the market?

Due to the mobility and the variable spectrum of electromagnetic railway environments, the robustness and the total absence of fault of the detection solutions is difficult to demonstrate aboard a train. However, when the train is not moving, SECRET technologies can be really efficient. So we can envisage reaching the market relatively quickly with these technologies to protect train stations or other critical infrastructures.

In parallel, SECRET's technologies can contribute to the evolution of telecommunication standards employed in critical infrastructure. Instead of improving performance in terms of data rate, the standards can evolve to provide real-time information about the quality of services or the presence of jamming signals (intentional or unintentional). They could then provide relevant diagnostics and activate the adequate intervention process.

★ European railways are already under high economic and security-related pressure. Do you think the sector can bear the extra cost which the implementation of SECRET's solutions would involve?

I think that with this growing threat, it will be necessary to guarantee the resilience of the railway network against such attacks. Usually wireless communication systems only represent a small percentage of the budget of a railway project. However these systems are essential in operational and security plans. EM attacks can have dramatic consequences in terms of cost, and if they are easy to implement, they can also become frequent malicious actions. So a solution against EM attacks should be considered while balancing risks, impacts and investments.

★ What are your plans now that the project is close to its end?

We would like to test our analysis of EM attacks with other types of attacks such as physical or other cyberattacks. In fact, jamming attacks can easily be employed in support of other malicious actions in order to avoid video or alarm transmissions. As a consequence, the risks analyses have to take into account potentially coupled physical and jamming attacks. We also think that the detection architecture for EM attacks proposed in SECRET should be coupled with other monitoring tools for infrastructure in order get a better grasp of what's happening on the network in real time.

SECRET

★ Coordinated by IFFSTAR in France.
★ Funded under FP7-SECURITY.
★ http://cordis.europa.eu/project/rcn/104352_en.html
★ Project website: http://www.secret-project.eu/

TIRAMISU DEMONSTRATES NEW DEMINING TOOLS IN BRUSSELS

The EU-funded TIRAMISU (Toolbox Implementation for Removal of Anti-personnel Mines, Submunitions and UXO) project uses robots and UAVs to disarm and dispose of anti-personnel landmines and 'unexploded ordnance' (UXOs), which commonly threaten post-conflict development and welfare.

Observing demining tools in action is, luckily, a rare thing in Belgium. However this is precisely the kind of spectacle stakeholders, policy-makers and curious citizens were offered on 5 and 6 May on the occasion of the 5th European Civil Protection Forum in *Parc du Cinquantenaire*, Brussels. Outdoor demonstrations of TIRAMISU's unmanned rotorcraft and Teodor UGV were organised, showcasing the full potential of these technologies.

Two specific capabilities of the project tools were successfully demonstrated in spite of challenging weather conditions: 3D mapping with an optical camera and demining with a near infrared camera. The TIRAMISU rotorcraft, the first of the two technologies to be used on-site, demonstrated its capabilities in assisting demining personnel in humanitarian operations after a flood — where landmines tend to shift locations. The rotorcraft's mapping abilities provide a 3D model of the environment which can then be used to predict the position of a shifted mine-field. Once this is done, a near-infrared camera is used to locate mines, while the Teodor UGV — an unmanned ground vehicle — assists the demining operation from the ground.

TIRAMISU, which kicked off in January 2012 and ends in December 2015, gathers together organisations which have been involved in some of the most important European and international research projects on mine action. It aims to develop a toolbox which can serve as a basis for a comprehensive, modular and integrated solution to the clearing of large areas subjected to explosive hazard. Specifically, the team is working on three sets of tools: demining planning tools to locate explosive devices and define contaminated areas, detection and disposal tools to help operators neutralise these devices, as well as training and mine risk education tools. In addition to the two technologies mentioned above, other exciting solutions such as training bees to sniff out explosives have been explored and tested by the project consortium.

The TIRAMISU tools have already been used in real life situations over the past few years, including assistance with relief operations after the floods that affected over 3 million people in Serbia and Bosnia in May 2014, mapping of the Svilaja and Dinara mountains in Croatia and mine risk education activities in Cambodia.

The final demonstration of the project tools is set to take place in September 2015, also in Belgium. Over 110 000 000 active landmines are still scattered around the world, and it is estimated that it would take some 1 000 years to clear all landmines and UXOs. The TIRAMISU robots could be key to accelerating the pace of demining without putting operators' lives under threat.

TIRAMISU

- ★ Coordinated by the Royal Military Academy in Belgium.
- ★ Funded under FP7-SECURITY.
- ★ http://cordis.europa.eu/news/rcn/123052_en.html
- ★ Project website: http://www.fp7-tiramisu.eu
- ★ http://bit.ly/1L2yaJh

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ADDRESSING SECURITY CHALLENGES

The EU-funded DOGGIES project is currently in the final stages of integrating and testing a new sensor to detect hidden persons, drugs and explosives at borders.

Border security is one of Europe's key security challenges. Developing practical ways to detect hidden persons and illegal substances at borders is instrumental in avoiding terrorism and detecting human trafficking and smuggling. Since June 2012, the DOGGIES (Detection of olfactory traces by orthogonal gas identification technologies) project has been working to demonstrate an operational, moveable, standalone sensor for detecting hidden persons, drugs and explosives.

The team is now at the point where all of the technology (hardware and software) building blocks are available and the final integration is ongoing. Getting to this phase involved concentrated research efforts focused on addressing trace detection that relied on a combination of two technologies based on completely different physical principles. The first is 'mid-infrared' (MIR) spectroscopy, which is based on photoacoustic detection. It appears to be the most powerful and promising tool for detecting a wide range of 'Volatile organic compounds' (VOCs). The second technology is ion mobility spectrometry, which targets the use of a non-radioactive ionisation source.

"The project team has plans for the various building blocks created within the project to be developed and brought to market."

DOGGIES project activities covered basic studies in physics and chemistry, as well as sensor engineering and field tests. Technical objectives that needed to be achieved include: identifying the operational specifications and end-user requirements; identifying the most relevant VOCs related to humans, drugs, and explosives or their precursors; demonstrating widely tuneable MIR sources; and demonstrating a miniature MIR photoacoustic spectrometer module.

Thanks to these efforts, the project, which comes to an end in November of this year, is well on its way to achieving its objectives. The definition of system requirements and specifications, along with three use case studies for final prototype assessment, have been completed. Furthermore, the main building blocks required to develop a moveable standalone detector are in place.

A first simple demonstration of detection using both DOGGIES techniques took place in May during a workshop for related EU projects and potential end users. The final instrument, which will be capable of complementing dogs currently at border and custom points, will be ready by August with the final assessment through lab and field trials to be conducted this autumn.

Although it is unlikely that the full instrument will be commercialised, the project team has plans for the various building blocks created within the project to be developed and brought to market. Project coordinator Bruno Gérard from III-V Lab in France notes, 'Just one month ago we created a start-up, called mirSense, to commercialise the new and innovative, widely tuneable MIR source developed within DOGGIES. Additionally, our partner GAS, a German SME, will probably upgrade its IMS products with the non-radioactive ionisation source validated within DOGGIES, and our partner GASERA, a Finnish SME specialised in photoacoustic sensors, will also propose new products thanks to the developments performed in the frame of our project. The pre-concentrator modules of our partner CNR-IMM will probably also be exploited in the future.'

Dr Gérard adds, 'The developed technologies will also be used, and further optimised and tested in other application fields, in other EU projects. For example, in the MIRIFISENS IP project looking at the application of MIR sensing (partly based on MIR sources close to the ones developed within DOGGIES) in various domains.'

A final workshop will be organised towards the end of the year to further promote the results and to give more demonstrations.

DOGGIES

- Coordinated by III-V Lab in France.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/157604_en.html
- Project website: http://www.fp7-doggies.eu/

PERSEUS RESEARCHERS MOVE ONE STEP CLOSER TO EU MARITIME SURVEILLANCE SYSTEM

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EU-funded researchers have recently been conducting marine observation tests with new generation underwater passive hydrophone.

The tragic loss of life in European seas has once more brought search and rescue operations and maritime surveillance to the forefront of public attention. EU researchers with the PERSEUS project are building and demonstrating an EU maritime surveillance system which aims to help us improve our knowledge of what is happening in European waters.

To this end, PERSEUS (Protection of European seas and borders through the intelligent use of surveillance) researchers recently conducted validation tests in the waters of La Spezia in Italy using an autonomous marine observation vehicle called Waveglider. A technical team from NATO's Centre

"The PERSEUS solution will provide a description of the situation from coastal areas to the open seas in real time."

for Maritime Research Experimentation (CMRE) joined forces with the Oceanic Platform of the Canary Islands (PLOCAN) to test Waveglider which housed a new generation underwater passive hydrophone. It's thought that the hydrophone could contribute to addressing one of the PERSEUS project's main challenges — underwater acoustic signatures detection and characterisation.

CMRE and PLOCAN are just two among the 33 partners on the PERSEUS project led by Indra in Spain. Prior to the recent tests, the project team had already completed two major demonstration phases, in 2013 with Portugal, Spain, France and Italy and in 2014 with Greece. In fact, for over four years now the consortium has been working towards the overall objective of building and demonstrating an EU maritime surveillance system integrating existing national and communitarian installations and enhancing them with innovative technologies.

One of the key aims of the PERSEUS team at the outset was to contribute to the European Border Surveillance System (EUROSUR) roadmap, at feasibility, standards, best practices and regulation levels. The PERSEUS solution will provide a description of the situation from coastal areas to the open seas in real time. It will also improve and automate detection and identification of suspicious or non-collaborative vessels, facilitating decision-making and reducing the response time of authorities. Besides this, it will facilitate assistance and coordination of interception and rescue at sea and will improve efficiency.

PERSEUS has been driving technological innovation, particularly regarding detection and analysis for the detection of low flying targets and small vessels. From the start, the team was keen to ensure that the system could allow for multiple sensors and sources of information to be incorporated into it. As an EU-wide system, it was also essential that the PERSEUS solution could be adapted continuously to new technologies, so that solutions employed at national level such as SIVE, SPATIONAV and others, as well as the European initiatives of the Frontex Agency, EUROSUR and DG MARE could be integrated.

The recent validation trials will soon be followed by a demonstration phase in May of this year in the waters of Gran Canaria. The project officially finishes at the end of June 2015. Ultimately, it is hoped that the strong collaboration between Member States within the multidisciplinary PERSEUS project team will help deliver comprehensive maritime surveillance from coastal regions to high seas.

PERSEUS

- Coordinated by Indra in Spain.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/news/rcn/122796_en.html
- Project website: http://www.perseus-fp7.eu/

MONITORING TERRORIST THREATS WITH AN URBAN SENSOR NETWORK

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The EU-funded PROACTIVE project has developed components and prototypes for an urban sensor network for monitoring terrorist threats and a system for evaluating the 3D city environment and human behaviours, and suggesting responses.

Terrorism has become a real and ongoing threat, but combating it is fraught with difficulty. Attacks are very difficult to predict, plus urban environments add additional vulnerabilities and constraints.

The PROACTIVE (PRedictive reasOning and multi-source fusion empowering AntiCipation of attacks and Terrorist actions In Urban EnVironmEnts) project, which concluded in April of this year with a final demo in Italy, aimed to provide

effective tools to remedy the situation. The 10-member consortium proposed a multi-sensor framework to aid with detection of urban terrorist threats, plus an evaluation system that suggests appropriate responses. The system is intended to incorporate novel technologies for combining multi-sensor data with 3D environmental or terrain information. Furthermore, the evaluation module incorporates advanced reasoning techniques, which also facilitate prediction of terrorist events.

"All of the final components and prototypes developed by PROACTIVE over the past three years were showcased at the PROACTIVE Final Demo in April of this year."

PROACTIVE used two key technologies to develop new real-time environmental awareness and behavioural-analysis capability. The team also addressed the technological challenges that inhibit general deployment of the technologies in anti-terrorism applications.

Researchers also developed, among other things, a multi-source data-fusion grid. The grid provides better coverage, thus improving local and global situational awareness. The information also helps to improve the confidence of threat declarations. A lower networking layer of the fusion grid supports efficient communication among the grid's nodes.

Additionally, team members developed a decision-support system, incorporating terrorist modelling and intent-referencing modules. Using machine learning and Bayesian networks, the system predicts terrorist goals and motivations, and recommends response actions.

All of the final components and prototypes developed by PROACTIVE over the past three years, including the Terrorist Reasoning Kernel and the Ad-Hoc Multi-hop Network, were showcased at the PROACTIVE Final Demo in April of this year. Hosted by project coordinator Vitrociset in Rome, Italy, the event saw the new technologies tested and evaluated by end-user experts in a 'near to operational environment'. According to the PROACTIVE team, one of the main focuses of the demo was to grasp the feedback of the PROACTIVE End-User Advisory Board on the demonstration of the project prototypes.

Feedback from the demo will no doubt serve to further enhance the project outcomes which the team hopes will improve public security and aid in more efficient emergency response.

PROACTIVE

- Coordinated by Vitrociset Spa in Italy.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/158597_en.html
- Project website: http://www.fp7-proactive.eu/

NETWORKING TO IMPROVE FOOD BIOSECURITY

A research and training network focusing on food biosecurity seeks to counteract possible bioterrorism threats to the European agri-food system.

Almost 15 years after the 9/11 attacks, terrorism remains one of the most serious threats to world peace. The recent attacks in France, Denmark and Belgium have reminded European decision-makers of how ubiquitous the problem has become, and increased security measures are likely to push terrorist organisations to resort to new methods. One of them is bioterrorism — the deliberate use of bacteria, viruses or toxins to cause mass panic, spread diseases, cause food losses or disrupt a country's economy.


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The EU-funded PLANTFOODSEC (Plant and food biosecurity) project, which was launched in February 2011 and ends in January 2016, is establishing a virtual Plant and Food Biosecurity Centre to enhance international preparedness against agroterrorism attacks, as a response to the EU's Green Paper on Biopreparedness published in 2007.

The team's work consists in analysing plant disease epidemiology, identifying priorities for research and regulatory policy, analysing the risk posed by new pests and disease agents, improving surveillance, detection and diagnostics, enhancing response measures, providing training, and raising awareness among stakeholders.

Increased awareness for effective response

So far, the team has already identified plant pathogens and pests that threaten the most important food crops as priorities for research and regulatory policy. They studied the fungal pathogen *Fusarium proliferatum*, which damages crops and impacts human health through cancer-causing toxins, as a model for deliberate pest introduction. They also carried out experimental work on leaf rust (*Puccinia triticina*) and septoria leaf blotch (*Zymoseptoria tritici*), two common wheat pathogens in Europe.

Human foodborne pathogens that cause disease outbreaks were also flagged as potential bioweapons. To contain threats from deliberate food contamination, structures were put in place for coordinated European-wide disease surveillance, detection and response programmes. A risk evaluation scheme specifically for agroterrorism threats has been developed, and a framework for a virtual web-based diagnostic network, called the

'EU plant and food security information system' (EUPFSIS), has been created. The system, which will officially be launched in 2016, can be used by diagnostic laboratories to upload records while preserving client confidentiality. Registered organisations have access to summary data for particular organisms throughout Europe, as well as community pages on emerging issues, protocol updates, workshops and training.

To date, 98 crop/pest/scenario combinations have been evaluated and 20 combinations presenting the most significant risk have been identified under different scenario types: 'biowarfare' (BW); 'bioterrorism' (BT); and 'biocrime' (BC). In the coming months, risk management measures that can be applied to each scenario will be identified by INRA and ANSES experts.

The Virtual Diagnostic Network and the Risk Assessment Tool were presented at a workshop in Szentendre, Hungary in April 2015. The capabilities of the Virtual Diagnostic Network and Risk Assessment Tool were introduced and stakeholders were provided with an opportunity to participate in demonstration cases.

One of the key remaining tasks for the project team will be to identify measures to prevent the spread of deliberately introduced pathogens in the EU. When completed, PLANTFOODSEC will have played a central role in plant and food biosecurity dissemination, awareness and communication, all this while improving national and regional responses to bioterrorism threats.

"They studied the fungal pathogen Fusarium proliferatum, *which damages crops and impacts human health through cancer-causing toxins, as a model for deliberate pest introduction."*

PLANTFOODSEC

- Coordinated by the University of Turin in Italy.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/157730_en.html
- Project website: http://www.plantfoodsec.eu
- http://bit.ly/1dj65Co

PROTECTING CIVILIAN INFRASTRUCTURE AGAINST ELECTROMAGNETIC ATTACK

EU-backed researchers have developed new ways of anticipating and reacting to electromagnetic attacks, and identified areas where strong preventative measures are needed.

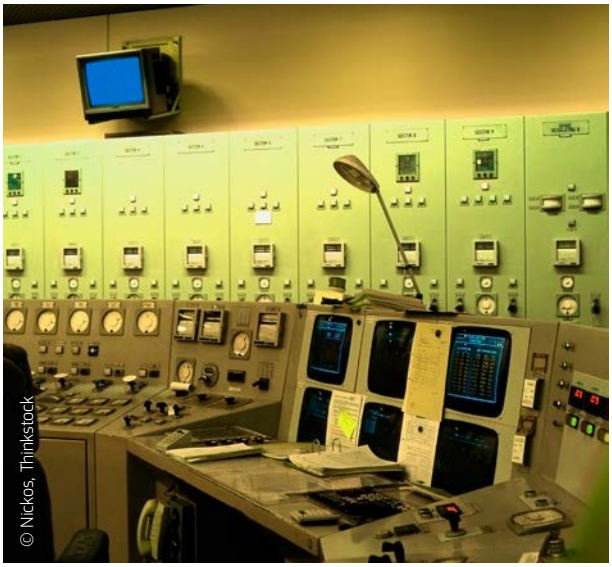
The EU-funded STRUCTURES (Strategies for the Improvement of Critical infrastructure Resilience to Electromagnetic Attacks) project has made a key contribution to identifying where civilian infrastructure is most susceptible to intentional, high-frequency 'electromagnetic interference' (EMI) attacks. The end result is a set of guidelines, procedures and tools that will make an important contribution to the continued socioeconomic well-being of the EU and its citizens, and of major parts of the rest of the world.

While EMI — caused by lightning, say — has always posed a recognised threat, the emergence of high-power, high-frequency devices capable of shutting down critical infrastructure on purpose poses a completely new challenge. The STRUCTURES project, launched in July 2012 and due for completion at the end of June 2015, began by identifying new protective measures and standards needed to counter this new cyber threat.

The focus throughout has been on civilian infrastructure — communications and banking for example — as these have tended not to have been designed to resist high-frequency EMI. Transport and energy distribution are two other key sectors that rely on the safe and secure transmission of data in order to properly function.

Through simulating EMI attacks against power plants and financial centres, scientists now have a much better idea of the susceptibility thresholds of vulnerable points. Furthermore, identifying key points of weakness will help governments to better target resources in the fight against cybercrime.

For example, the team found that cars equipped with remote keyless entry systems are especially vulnerable to EMI, as the encrypted signal between the key fob and the car can deliberately be jammed. Car security should therefore be reassessed.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Project partners also looked into radio communication involving civil emergency services such as the police and fire service, which will soon use digital broadcast networks. Potential threats were investigated and evaluated, and key points of susceptibility identified. New easy-to-use techniques for identifying the types of waveform typically associated with EMI attacks have been developed.

STRUCTURES

- Coordinated by IDS Corporation in Italy.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/154501_en.html
- Project website: http://www.structures-project.eu/

BETTER UNDERSTANDING PUBLIC VIEWS ON SECURITY AND PRIVACY

A recently published user guide could help those on the front line of security to better understand public concerns regarding privacy.

Privacy and data protection are fundamental rights that play a crucial role in contemporary democratic societies. This is the key reason why the use of surveillance technology, which has expanded in order to counter increasingly complex and sophisticated security threats, has become such a hugely sensitive and controversial issue.

A careful balance must be struck between maintaining public trust and privacy concerns on the one hand, and meeting the demand for security on the other.

To this end, a user guide designed to help policymakers and stakeholders take privacy and societal factors into consideration when evaluating security measures was recently published. The guide was one of the last deliverables of the EU-funded PACT (Public Perception of Security and Privacy: Assessing Knowledge, Collecting Evidence, Translating Research into Action) project, officially completed at the end of January 2015.

The PACT project sought to develop a new reference framework for assessing security investment from a wider societal perspective. In order to achieve this, the project team carried out the first pan-European survey on public preferences and trade-offs between security, privacy and fundamental rights. The team working on PACT also wanted to analyse the main factors that influence public opinion towards modern security technology.

Meetings with experts and focus groups were also organised. Interested stakeholders included security providers, border control authorities, law enforcement agencies, intelligence agencies and crisis managers.

The views and data collected then fed into the development of the guide, which provides insight into how privacy and fundamental rights challenges associated with the use of security technologies must be taken into account. A Decision Support System tool that addresses security technologies as they relate to privacy issues has also been designed, and was evaluated in relation to real-life environments.

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PACT
- Coordinated by Absiskey in France.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/155988_en.html
- Project website: http://www.projectpact.eu/
- http://bit.ly/1MonXYB

PROMOTING BEST PRACTICE IN CYBER DEFENCE

New technologies and best practices have been developed to help secure critical infrastructure against possible future cyberattacks.

The EU-funded PRECYSE (Prevention, protection and REaction to CYber attackS to critical infrastructures) project, officially completed at the end of February 2015, has helped to boost the resilience of ICT systems that support critical infrastructure such as power stations, transport hubs and communication networks. This has primarily been achieved through the integration of a number of state-of-the-art and emerging technologies in the field of network defence, and through highlighting best practices that are transferable from one industry to another.

The PRECYSE project tapped into the fact that securing critical infrastructure has become a government priority. This task has been made more difficult in recent years by the increasing sophistication of computer attacks. Since add-on security solutions have been shown to be largely ineffective in meeting the challenge posed by cyberattacks, it has become clear that new security measures integrated directly into control systems are urgently needed.

From the beginning, the project sought to generate tools that are

"Two pilot sites were established in order to assess these new tools, methods and techniques."

platform-neutral by design, ensuring that the impact of PRECYSE is as wide as possible. Two pilot sites were established in order to assess these new tools, methods and techniques; one in the energy sector and another in transportation.

These two virtual environments enabled the project team to emulate realistic conditions, and to accurately assess the ICT needs of both industries.

The project team was also able to see which technologies were best suited to boosting resilience against possible cyberattacks.

The end result is a set of methods and technologies capable of preventing, protecting and reacting to cyberattacks, available to a broad selection of end users. In March 2014, the project held an end user group workshop in order to provide direct feedback to interested stakeholders.

PRECYSE

★ Coordinated by ETRA in Spain.
★ Funded under FP7-SECURITY.
★ http://cordis.europa.eu/result/rcn/154519_en.html
★ Project website: http://precyse.eu/
★ http://bit.ly/1dOlZ8N

INTERVIEW

3D ACQUISITION OF FORENSIC EVIDENCE PRESENTS CRIME SCENE ANALYSTS WITH NEW PERSPECTIVES

If you are into TV crime series, you have probably noticed how the likes of traces on bodies or shoe prints often help detectives to shorten their list of suspects. Such forensic evidence also plays a key role in real investigations, but state-of-the-art techniques have their limitations. Technology developed under the 3D-FORENSICS project will help greatly improve the precision of these analyses thanks to the use of 3D laser scanning technology.

Since 2003, the number of crimes recorded in the EU has constantly been decreasing. But while the capturing and analysis of forensic evidence — from fingerprints to ballistics and serology — has been instrumental in this trend, these methods still have some shortcomings. There are, for instance, doubts about the unique character of an individual's fingerprints or the criteria to declare a match in hair and fibre analysis. Then, the methods used to gather forensic evidence sometimes lack accuracy and it can be difficult to guarantee their integrity from the crime scene to the court.

Of all these problems, the last two were the focus of the 3D-FORENSICS (Mobile high-resolution 3D-Scanner and 3D data analysis for forensic evidence) project, which aims to increase the accuracy, flexibility and resolution of 3D-reconstruction — a promising forensic approach to the reconstruction and analysis of evidence.

Since May 2013, the seven-strong consortium, led by Fraunhofer and comprising five SMEs, has been developing three prototypes of 3D-scanning systems along with new data analysis software. The system, which promises to make data acquisition more detailed and relieve experts from data processing by hand, aims to help the EU increase its rate of crime solving, which is still somewhere in the 70% range.

Dr Peter Kühmstedt, coordinator of 3D-FORENSICS, details some of the project's outcomes and his hope for the commercialisation of the newly-developed prototypes in the near future.


© Peter Kühmstedt

DR PETER KÜHMSTEDT

★ **The share of unsolved crimes remains worrying in Europe. How do you explain it?**

Dr Peter Kühmstedt: I think Europe has been strongly affected by the debt crisis in recent years. Many states reduced their budgets for fighting crime, especially for 'High volume crimes' (HVC), such as burglary and car crime. The investigation teams have limited resources for such cases. In my opinion, this issue seems to be one cause for crimes remaining unsolved, but there are no doubt many other reasons.

★ **How can 3D-reconstruction of evidence help improve these statistics?**

Optical 3D scanning technology has made much progress over the last 20 years. Typical applications are in the areas of industrial process control, architecture and cultural heritage.

The main objective of our project is the application of 3D technology to collect and analyse specific types of traces

from crime scenes, namely footwear and tyre impressions. Statistics in the Netherlands show that footwear and tyre impressions are a common trace at HVCs. The techniques used to capture these traces are typically photography or plaster casting but both techniques have their disadvantages: for instance photographs contain no information on depth and plaster casting is very time-consuming. These disadvantages can lead to 'Crime scene investigators' (CSIs) deciding not to collect these kinds of traces. Our technological approach is designed to overcome such disadvantages.

Optical 3D-scanning enables quick and contactless capturing of impression traces with detailed information. The analysis of digital 3D-data instead of plaster casts will ease the work of forensic experts and will enable increased linking of data from different crime scenes.

★ What is new about 3D-FORENSICS' approach to this 3D-reconstruction?

3D laser scanning technology is already used by some police and private forensic experts e.g. to record complete crime scenes, but it requires specialist knowledge and the systems have not been designed for the collection of footwear and tyre impressions. Our complete system, including 3D-scanner and analysis software, is the first system specifically designed for application at HVCs. It is designed to be used in the complete investigation and prosecution process fulfilling all legal requirements. If we achieve our goals, there is the possibility that plaster casting for footwear and tyre impression will be completely replaced.

Our 3D scanning technology is based on the principle of fringe pattern projection. This approach is enabling us to build a compact 3D-scanner that is easy to use. Compared to present state-of-the-art laser scanners it captures a 3D scene in a smaller field of view, approximately the size of a shoe sole with a resolution better than 0.2 mm. The resolution enables the visualisation of tiny identifying marks, such as small scratches which can be used to match impressions to a suspect's shoes. In addition, the analysis software mimics the present forensic analysis process for footwear and tyre impressions. It is simple to use and includes tools to determine class characteristics, such as shoe type and size and individual characteristics such as scratches.

★ Evidence is not easy to gather and maintain up to the point where a case goes to court. How does your technology help guarantee its validity and integrity?

We are lucky that our project team involves not only technologists but also forensic end users. In the beginning of our project we defined the requirements, such as transparency and the prevention of data manipulation, to ensure that evidence collected and analysed with the system will be admissible in court. The design and development which followed complied with these requirements. By way of example, the raw scan data is never irreversibly modified during the analysis process: each analysis step is logged and can be undone and redone.

"The resolution enables the visualisation of tiny identifying marks, such as small scratches which can be used to match impressions to suspect's shoes."

However special functionalities in the system are only one way of ensuring admissibility in court. The second, perhaps more important part, is to convince the forensic experts. If the experts are convinced by the system and trust the results, they will not hesitate to seek to use them in court. Validation within an accredited forensic process is not within the parameters of the project, but this would be a further step during commercialisation.

★ How are the prototype trials going so far?

In April 2015 we completed three prototypes of the 3D-scanner as well as the prototype software, including all the necessary tools for data analysis. The first tests in the laboratory are finished and showed very promising results. We have now progressed to field testing in simulated crime scene environments. Different representative undergrounds such as sand, clay and snow are being used. During the testing we are also comparing the results with classical methods such as plaster casting to document the advantages of our technique. The progression from laboratory to field conditions is often a hard step but we are keen to prove our system in the field environment in the time remaining in this project.

★ What are the remaining tasks for your team before project completion?

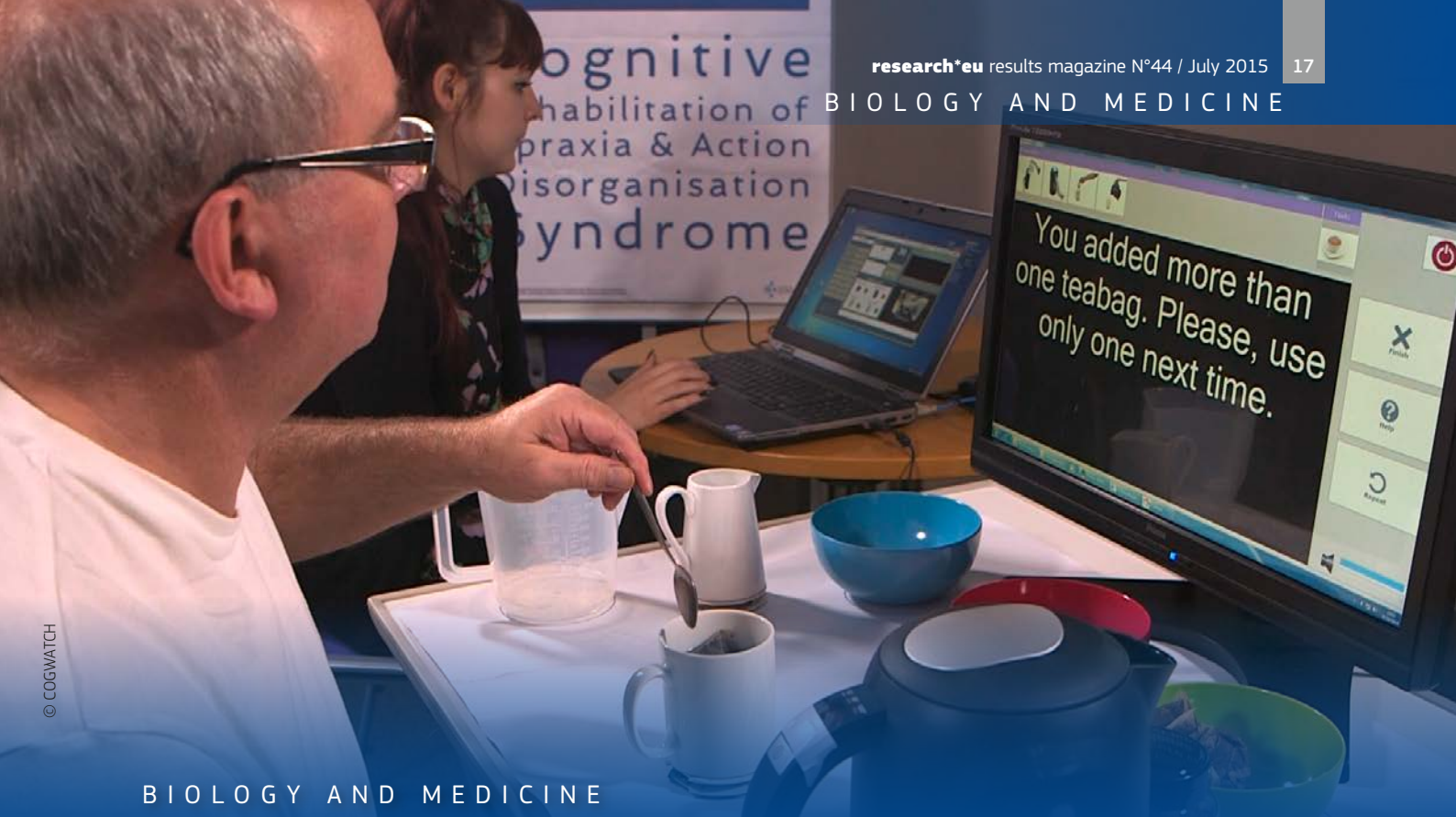
Our project has an overall duration of 28 months and ends in August 2015. In the first two years we defined the end user requirements, designed and developed the system and built up the prototypes. In the remaining time we will concentrate on field testing and evaluation. The main objective is to prove functionality in the field environment.

★ What are your plans for commercialisation and when can it be expected?

The results of 3D-FORENSICS are prototypes of a system to capture, analyse and investigate footwear and tyre impressions from crime scenes. As soon as the functionality and utility of the prototype are proven, an extra step is needed to take the system from prototype status to a commercial product. The remaining project time will also be used to identify technical aspects which could be improved for commercialisation. In parallel the consortium has also been developing an exploitation strategy and is presently considering the different funding options in order to proceed with the steps towards commercialisation. The goal is to engineer a product in 2016 and to have it on the market in 2017.

3D-FORENSICS

★ Coordinated by Fraunhofer in Germany.
★ Funded under FP7-SECURITY.
★ http://cordis.europa.eu/project/rcn/108475_en.html
★ Project website: http://www.3d-forensics.de/



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BIOLOGY AND MEDICINE

HELPING STROKE PATIENTS TO REGAIN THEIR INDEPENDENCE

A home rehabilitation system is helping stroke patients to remaster sequential daily tasks like brewing tea.

Strokes are the second leading cause of death worldwide; they kill more than 1 million people in Europe each year, accounting for 14% of all deaths. About a third of the 8 million stroke survivors in the EU are left with some degree of physical or cognitive impairment affecting their ability to plan and carry out actions.

While there are already many rehabilitation ICT systems focused on treating the physical symptoms of stroke, such as hemiparesis, there aren't many for the rehabilitation of cognitive impairments. The EU-funded COGWATCH (Cognitive Rehabilitation of Apraxia and Action Disorganisation Syndrome) project has developed a rehabilitation system to help improve the cognitive functions of stroke survivors.

Stroke patients can have trouble performing ordered sequences of movements, such as those required to brush their teeth or to make a cup of tea. These are often symptoms of 'Apraxia or action disorganisation syndrome' (AADS). COGWATCH is using intelligent tools and objects, portable and wearable devices as well as ambient systems to provide support at home to patients with AADS symptoms.

'We take it for granted that we can perform these activities of daily life,' says Professor Alan Wing, the project's coordinator and a faculty member of the School of Psychology at the University of Birmingham. 'Yet many of these seemingly simple tasks are actually complex and involve a large number of small steps that must be performed in the correct sequence.'

As simple — or complex — as brewing a cup of tea

The COGWATCH scientists customised a prototype that helps stroke patients brew a cup of tea — a complex sequential daily task. The system consists of two tablet computers, one for the patient and one for his or her clinician, and sensors attached to the bottom of objects such as the cup, milk jug and kettle that track the objects' movement, while a video camera records the entire process from overhead. On the tablet, the patient can choose an action, for example preparing a cup of tea with milk and sugar.

An action-recognition system is then activated: it receives information from the sensors and compares it with the task model corresponding to the steps of preparing a cup of tea with milk and sugar. If the patient makes an error while preparing the tea, the system prompts the correct action using any combination of video, audio, text or vibration to suggest the right step.

Professor Wing, 'As a patient, it is as if there is someone beside you to tell you what to do, but they allow you to act independently if you want to be independent.'

Tea-making results

To test the system, the COGWATCH researchers conducted a randomised study with 30 patients. Compared with the control group, participants who were trained using the COGWATCH system, showed statistically significant improvements in tea-making performance; they made 54% fewer errors and showed a 20% reduction in time taken to make a cup of tea.

Better care

Apart from helping stroke patients regain independence, the COGWATCH system could also enable occupational therapists to work with more patients or develop more of each patient's skills. The system already provides useful information on the patient's task performance over time.

Longer term, COGWATCH could result in patients being discharged earlier, thus lowering their risk of infection, allowing them to return to their familiar home environment, and freeing up bed space.

COGWATCH ran from 1 November 2011 to 28 February 2015 and received EUR 3.7 million in EU funding.

'We would eventually like to offer systems that are affordable enough for home use so that, for example, every hospital could loan them out to its patients,' concludes Professor Wing.

"If the patient makes an error while preparing the tea, the system prompts the correct action using any combination of video, audio, text or vibration to suggest the right step."

COGWATCH

- Coordinated by the University of Birmingham in the United Kingdom.
- Funded under FP7-ICT.
- http://cordis.europa.eu/result/rcn/162534_en.html
- Project website: http://www.cogwatch.eu/
- http://bit.ly/1dlED1y

HOW RAPID TB TESTING COULD REVOLUTIONISE GLOBAL HEALTHCARE

EU-funded scientists with the PATHSEEK project have developed rapid antimicrobial resistance testing, enabling personalised tuberculosis treatment quicker than ever before.

Tuberculosis — or TB — is an infectious disease that spreads through the air and globally results in one death every 24 seconds. In 2013 there were between 1.3 and 1.5 million associated fatalities, mostly in developing countries. However, TB disease rates in some parts of London have been found to be as high as in Sub-Saharan Africa, with drug-resistant strains becoming increasingly common.

The prevalence of drug-resistant strains has placed enormous pressure on health professionals to achieve quicker diagnoses and provide more targeted treatments to individual patients. Scientists, working together as part of the EU-funded PATHSEEK (Automated Next Generation Sequencing for Diagnostic Microbiology) project, believe they have achieved a key breakthrough in this regard.

This breakthrough is based on whole genome sequencing, which provides a sort of 'print out' of a patient's complete genetic code. This method enables medical staff to pinpoint drug resistant mutations of TB, and from this, offer more effective personalised treatments. A key obstacle however has been the fact that genome sequencing can take weeks. DNA samples need to be grown in the laboratory before there is enough genetic material to measure.

"PATHSEEK scientists are also confident that the new method will enable researchers to precisely track the spread of TB."

What the PATHSEEK scientists have done is to find a way of dramatically speeding up this method. This involves extracting mucus samples and using probes made of 'ribonucleic acid' (RNA) molecules, engineered to bind to TB DNA. This method has been tested on 34 routine samples taken from patients in London and Lithuania, where resistant TB strains are a significant problem.

The project has also developed user-friendly bioinformatics software for making quick diagnoses. Using this software, sequencing data can be analysed for drug resistance, helping to guide appropriate treatment and timely identification of outbreaks.


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The potential benefits are huge. Patients no longer need to wait for up to six weeks to get the right treatment and the risk of further infections is substantially lower, since quick identification of TB bacteria also allows for quick quarantine decisions to be made.

PATHSEEK scientists are also confident that the new method will enable researchers to precisely track the spread of TB. Rapid sequencing will make it possible to identify highly infectious individuals — who are sometimes called 'super-spreaders' — thus helping health professionals to control and prevent future outbreaks of the disease. The team hopes to further refine the technique and make it cheaper for developing countries where drug-resistant TB is common.

The technique has also been applied to other infections including chlamydia, HIV, hepatitis, herpes, influenza A, norovirus and cytomegalovirus. Although many infections can be treated with antimicrobials, resistance is a growing global problem. Diagnostic techniques that enable more precise treatments to be given earlier could help to combat drug resistance in a wide range of infections, not just TB.

The PATHSEEK project, which runs until 31 August 2015, has been a collaborative effort led by University College London together with three other partners: Oxford Gene Technology in the UK, CLC bio in Denmark and Erasmus Medical Centre in the Netherlands. The project received a total of EUR 5.9 million in EU funding.

PATHSEEK

★ Coordinated by University College London in the United Kingdom.
★ Funded under FP7-HEALTH.
★ http://cordis.europa.eu/news/rcn/123005_en.html
★ Project website: http://www.pathseek.eu/

BRUSH AND FLOSS OFTEN TO WARD OFF HEART ATTACK

The mouth is teeming with bacteria, most of them harmless. However, EU-funded scientists have shown that they often find their way to the arteries, remaining dormant until some trigger causes them to play a role in heart attack.


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The Consorci Institut Catala de Ciencies Cardiovasculars (ICCC) in Spain was among the first to demonstrate an association between dormant invasive bacteria and degenerative tissue on artery walls. ICCC scientists also developed a method to isolate and cultivate bacterial pathogens from patient tissue for the first time.

The group recently completed work on an EU-funded study of patients undergoing surgery for arterial obstruction. The results of the project CARDIOMICROBIOME (Discovery of atherosclerosis microbiome: Systems biology of cardiovascular pathogenesis) point to a different microbial environment in atherosclerotic tissue compared to that in healthy vascular tissue. This may partially explain why atherosclerosis does not always follow the patient profile associated with hypertension, hyperlipidaemia, diabetes and smoking.

In particular, using advanced molecular probes it was shown for the first time that within the same individual, there was a higher presence of bacterial species compared to a similar sample of healthy tissue. These bacteria are known to induce clotting of the blood. This points to a model where, unlike in the mouth, the bacteria in the arteries go relatively unnoticed for a long period of time, causing chronic low-grade inflammation. At some point, an as yet unclear trigger causes them to play a role in heart attack or stroke.

The data also support previous results from the same research group showing periodontal bacteria in the carotid arteries, the large arteries in the neck that carry blood from the heart to the brain. This provides a potential link between oral hygiene and brain-related diseases such as ischemic stroke and neurodegenerative conditions that requires further investigation.

CARDIOMICROBIOME results are important for a number of reasons. The link between oral hygiene and cardiovascular health provides a straightforward route to prevention of cardiovascular diseases through improved tooth and gum care. Identification of the bacteria present in the arterial plaques opens the door to use of antibiotics to treat atherosclerosis. Finally, demonstration of bacterial species from the mouth in the blood highlights the possibility of those bacteria setting up house virtually anywhere in the body.

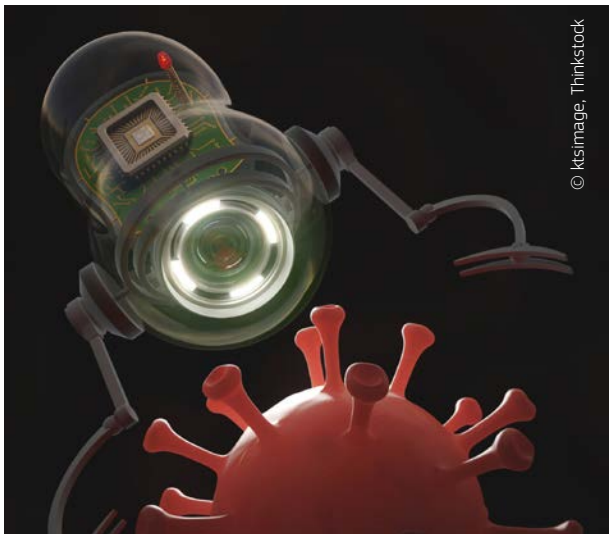
The project has answered significant questions and, as all good research should, identified new ones and the direction of future studies. In practical terms, the potential benefits for healthcare costs and patient morbidity cannot be underestimated.

CARDIOMICROBIOME

★ Coordinated by ICCC in Spain.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159861_en.html

MINIATURE DEVICES FOR BIOMEDICAL USE

Chinese and European researchers have joined forces to develop novel miniature devices for the biomedical field. Exploiting nano-patterning and microfluidics, the plethora of systems and applications promises to revolutionise analytics and delivery of minute amounts of fluids.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Miniaturisation of bioanalytical platforms can significantly enhance processing speeds due to fast handling and reaction kinetics of minute sample volumes. This eventually is a promising step towards single-molecule or single-cell resolution.

A fruitful collaboration between Chinese and European research institutes fostered extensive development in the fields of microelectromechanical systems and microfluidic devices for biomedical applications. EU funding of the project MICROCARE (Microsystems and bioanalysis platforms for health care) supported the effort.

Research focused on exploiting the versatility of silicon micro- and nanofabrication technologies to produce systems and devices for biochemical analysis and microdelivery. The team combined nano-patterning techniques and advanced polymeric materials such as transparent conductive polymers and piezoelectric compounds.

More specifically, scientists developed surface structuring and chemical organisation methods as well as techniques to produce micro- and nano-structured patterns. The latter were used to study the role of surface patterning on cellular behaviours such as differentiation, growth and alignment. Partners also designed and tested the feasibility of microfluidic channels with integrated micro- and nano-patterned structures, which were generated by nanoimprint lithography.

Among the numerous devices achieved within the four-year MICROCARE project were new scaffolds for tissue engineering and novel microfluidic devices for diagnosis of tumour cells and for the study of synthetic and systems biology. Chemical and biological sensors of oxygen, glucose and lactate will aid not only in diagnosis of diseases but also in understanding chemical signalling in cells. In the future, such platforms may be used to actually control cell signalling and cell regulation. Scientists integrated some devices for 3D imaging or spectroscopy.

The large variety of miniaturised sensor devices and novel techniques developed within the scope of MICROCARE could have important benefits in the healthcare realm and beyond. Advancement in portable, efficient and reliable diagnostics with lower costs and faster throughput will enhance the European competitive position in a large global market while enhancing quality of life for EU citizens.

MICROCARE

- ★ Coordinated by the Science and Technology Facilities Council in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159840_en.html

A BREATHTAKING SOLUTION TO EARLY CANCER DETECTION

EU-funded researchers have developed a breath test that can detect precancerous gastric cancer lesions, and potentially save thousands of lives.

New technology capable of detecting minute changes in exhaled breath could help signal the onset of gastric cancer. Scientists developed the accurate and inexpensive method of analysing certain atoms from breath samples thanks in part to a EUR 1.2 million FP7 European Research Council (ERC) grant. Some landmark findings have just been published in the academic journal Gut.

"The DIAG-CANCER team was capable of discriminating between patients with gastric cancer and the control group with a reported accuracy level of 92 %."

Completed at the end of 2014, the DIAG-CANCER (Diagnosis, Screening and Monitoring of Cancer Diseases via Exhaled Breath Using an Array of Nanosensors) project represents an important breakthrough in effective cancer screening and prevention. Until recently, widespread screening has only been available for a few cancers, most notably cervical cancer, where the management of screen-detected lesions has reduced incidences by 80 %. When it comes to gastric cancer in Europe however, most patients have until now been diagnosed in the advanced stages of the disease.

The four-year DIAG-CANCER project sought to find a new, inexpensive means of distinguishing between malignant and non-malignant gastric conditions. The team harnessed the potential of nanotechnology, which uses materials at the atomic, molecular and even macromolecular scale, where properties differ significantly

from those at a larger scale. The chemical nature of certain cancer biomarkers was also identified through spectrometry, an analytical chemistry technique that helps identify chemicals present in a sample.

For the gastric cancer breath test, a total of 968 breath samples were collected from 484 patients (including 99 with gastric cancer). Researchers reported that patients with cancer — as well as those at high risk — had distinctive breath-print compositions. They found that systematic oxidative stress — a condition that is thought to be involved in the development of cancer — generates alkanes such as ethane, pentane and other saturated hydrocarbons. A total of eight of these significant volatile organic compounds were detected in exhaled breath in the different comparisons.

Most significantly, the prototype test proved capable of identifying different stages of precancerous gastric lesions. Furthermore, the presence of precancerous stomach lesions could be detected whether or not other factors, such as smoking or heavy alcohol consumption, were in play.

In fact, the analysis developed by the DIAG-CANCER team was capable of discriminating between patients with gastric cancer and the control group with a reported accuracy level of 92 %. Researchers also believe that the breath test has huge potential as an invaluable follow-up tool for the surveillance of high-risk patients, and could be used to detect other diseases and lesions.

It is hoped that the new breath test can effectively address this critical weakness. After all, early diagnosis plays a significant role in determining a patient's chances of survival. DIAG-CANCER's simple breath test analysis could soon provide the missing non-invasive screening tool for gastric cancer and related precancerous lesions, offering hope to thousands of at-risk patients.


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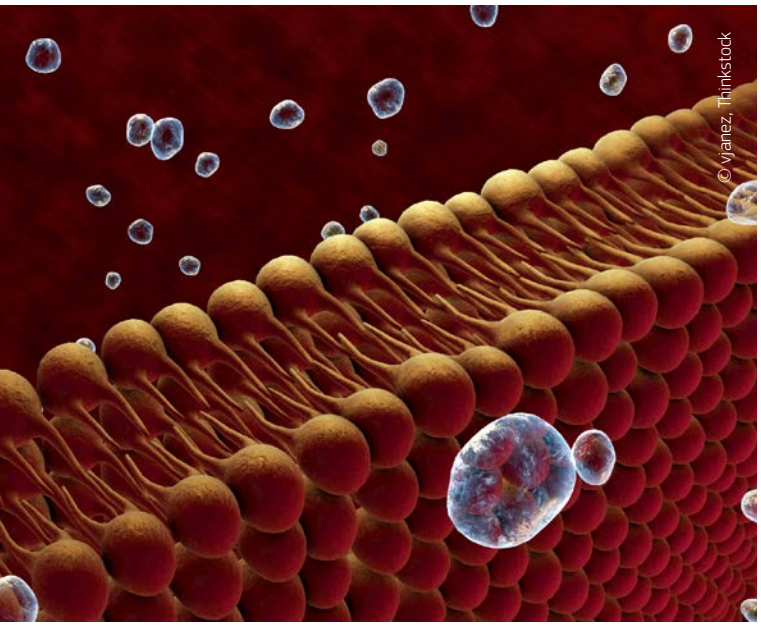
Finally, as the test can be administered outside specialist settings, it also has the potential to lessen the burden on healthcare budgets, both through simple low-cost testing and through earlier and thus more cost-effective treatment.

DIAG-CANCER
- ★ Coordinated by Technion in Israel.
- ★ Funded under FP7-IDEAS-ERC.
- ★ http://cordis.europa.eu/news/rcn/122745_en.html

CLINICAL APPLICATIONS OF ELECTROPORATION

Electroporation is a technique used to increase cell membrane permeability to ions and molecules using short pulses of high electric fields. Recent advances show electroporation applications for clinical cancer treatments.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Electroporation routinely facilitates *in vitro* gene transfection in microbiology laboratories. Recent discoveries show that electroporation can also enhance *in vivo* gene transfection and uptake of chemotherapeutic agents. The potential of electroporation to ablate tissues in a non-thermal mode has promoted its use for cancer treatments.

The EU-funded project TAMIVIVE (Tools and methods for *in vivo* electroporation) focused on clinical treatments based on electroporation. Depending on the number of pulses, their magnitude and duration, membrane permeabilisation induced by electroporation can be either temporary or permanent.

While reversible electroporation does not compromise viability of the cell, permanent electroporation disrupts cell homeostasis, inducing cell death. Reversible electroporation is the basis for electrogenetherapy, facilitating gene delivery to cells by electric pulses. Another method, electrochemotherapy, follows the same principle, enhancing penetration of anti-cancer drugs into malignant cells in tissue. On the contrary, permanent electroporation is the basis of the novel non-thermal tissue ablation method. Termed non-thermal irreversible electroporation, it is used to destroy solid tumours.

"The project produced wide-ranging results in the field of electroporation, yielding six peer-reviewed journal publications and two patents."

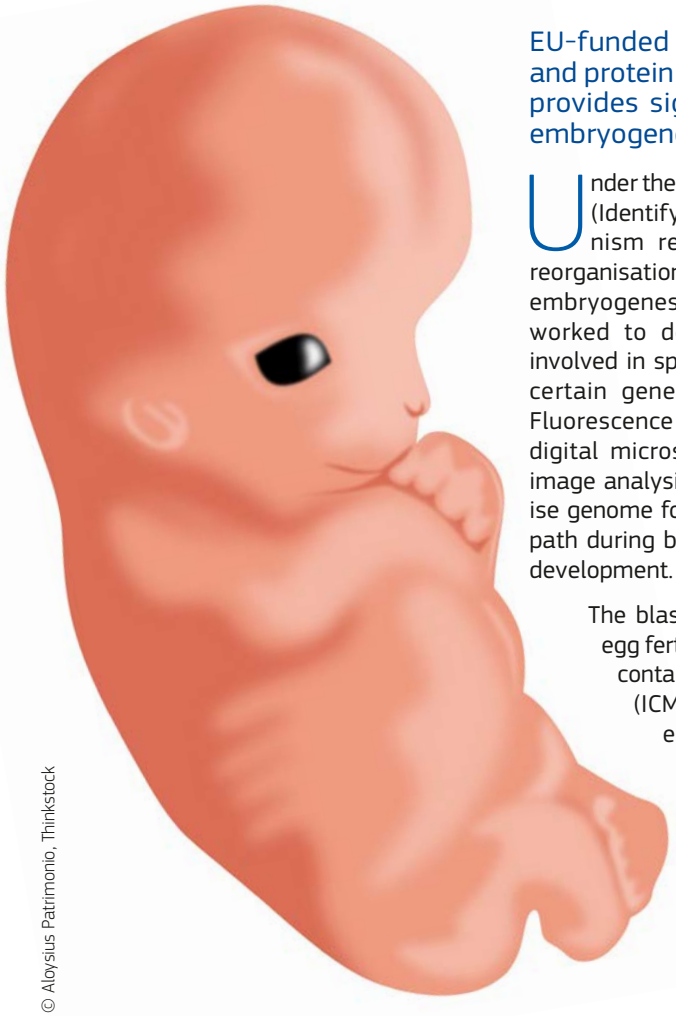
The project produced wide-ranging results in the field of electroporation, yielding six peer-reviewed journal publications and two patents. An ongoing collaboration with a team of clinicians addresses treating multiple liver tumour nodules by irreversible electroporation. Other applications

of irreversible electroporation demonstrated in the project are pancreatic tumour ablation in mice and liquid media pasteurisation.

Electrodes and microstimulators belong to a closely related area of research. As a result of this project, a patent on minimally invasive electrodes for clinical electroporation is pending. In addition, the project developed a method to perform functional electrical stimulation by means of implantable microstimulators. The many clinical applications of these electrodes include addressing complex neurological disorders such as spinal cord injury. Overall, TAMIVIVE resulted in significant advancements in the field.

TAMIVIVE
★ Coordinated by Pompeu Fabra University in Spain.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159850_en.html

GENOME REGULATION DURING EMBRYOGENESIS



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EU-funded researchers have investigated genome regulation and protein folding in early mammalian development. Their work provides significant insight into genome function during early embryogenesis.

Under the aegis of the IMMRSRGE (Identifying molecular mechanism responsible for spatial reorganisation of the genome during embryogenesis) project, scientists worked to determine the factors involved in spatial reorganisation of certain gene loci in the nucleus. Fluorescence *in situ* hybridisation, digital microscopy and automated image analysis were used to visualise genome folding and their folding path during blastocyst implantation development.

The blastocyst is formed after egg fertilisation in mammals. It contains an 'Inner cell mass' (ICM) that later forms the embryo. From the ICM, two distinct layers arise, the epiblast and hypoblast. This period of blastocyst implantation development is marked by substantial nuclear reorganisation.

Just like the pluripotent 'Embryonic stem cells' (ESCs) isolated from mammalian ICM, epiblast SCs (epiSCs) are also pluripotent. This has significant implications for biomedicine. Researchers focused on studying genes that move away or towards the nuclear periphery when mouse ESCs differentiate into epiSCs.

The RNA interference technique was employed to selectively inhibit gene expression after the knockdown of proteins involved in modulating chromatin structure and organisation. The DNA sequences linked to the lamin B1 protein were selected for study. This data was correlated with epigenomic data sets of histone modifications before and after ESC differentiation.

Scientists successfully identified a modified histone involved in aberrant gene relocation to the nuclear periphery in ESCs. These genes normally relocate to the nuclear periphery only during the epiblast stage of development. This led to analysis of other chromatin factors linked to the candidate histone modification and their possible role in genome reorganisation in the nucleus.

Project findings were presented at two international meetings in 2013 and are also being prepared for publication.

Besides unravelling the intricacies of genome function in disease and health, applications include tissue regeneration and cell therapy using either ESCs or epiSCs.

"Scientists successfully identified a modified histone involved in aberrant gene relocation to the nuclear periphery in ESCs."

IMMRSRGE
★ Coordinated by the University of Edinburgh in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159870_en.html

SOCIAL SCIENCES AND HUMANITIES

THE EFFECTS OF NEW PUBLIC MANAGEMENT

An EU-funded team has investigated the social effects of 'New public management' (NPM). Examining public/private sector coordination, the fiscal crisis and the impact of public services on social cohesion, the study showed areas of improvement and decline.

NPM is an administrative concept introduced in the late 1980s intended to improve efficiency through privatisation, downsizing and openness to private sector influence. Certainly, NPM has had strong effects on European countries, but whether these have been socially positive is debatable.

The EU-funded COCOPS (Coordinating for cohesion in the public sector of the future) project examined this question. The aim was to assess the impact of NPM reforms in European countries, addressing public management, public services and social cohesion. The project's 10 objectives included evaluation of innovative coordination and reintegration practices, and determination of future trends in the public sector. COCOPS operated between early-2011 and mid-2014.

First, the team compiled an accessible database of over 500 documents, used to examine the effects of NPM-style reforms in European countries. The work found few reliable studies. Changes in public spending have also varied across countries since the 1980s, confounding the analysis, since the effects may have been related to cost cutting rather than NPM.

The project queried the views of senior public officials and citizens. The resulting survey became one of the largest records on the subject, containing around 10 000 responses. The resource made it possible to compare the views of senior public sector managers in 20 countries on a wide range of NPM themes.

Researchers addressed three challenges facing the public sector: the need for sector coordination, the fiscal crisis and the impact of public services on social cohesion. COCOPS also considered innovative arrangements developed within the public sector to address cross-cutting policy issues, and matters of coordination between public and private sectors. The work demonstrated how cutbacks impacted the government sector, and described how different reforms have affected social cohesion, equality and inter-group tensions.

Further enquiries sought the views of additional stakeholders regarding what they see as the main challenges. The respondents strongly agreed on key trends over the last five years. Cost efficiency, transparency and service quality improved the most; issues having worsened include citizens' trust in government, the attractiveness of government as an employer and social cohesion.

COCOPS developed a substantial knowledge base containing the viewpoints of stakeholders concerning NPM reforms. The project also stimulated debate about the topic, aiding public sector reform.

COCOPS

- Coordinated by Erasmus University Rotterdam in the Netherlands.
- Funded under FP7-SSH.
- http://cordis.europa.eu/result/rcn/159831_en.html
- Project website: http://www.cocops.eu/

SMEs AND EXPERIENCE STAGING

An EU team has helped European 'Small and medium-sized enterprises' (SMEs) utilise the concept of experience staging. Using surveys and longitudinal studies, the study yielded recommendations for businesses to implement a strategy of experience staging.

Technological innovation is a high priority for Europe. However, that alone does not guarantee market acceptance, and instead competitiveness may depend on less tangible factors such as experience staging.

The 'experience economy' is the fourth stage in the progression of economic value. The EU-funded project STAGEIT (Transforming SMEs into successful experience stagers) investigated how companies can improve competitiveness through experience staging. The project aimed to transfer knowledge from academia to the industrial partners via secondments.

"The project aimed to transfer knowledge from academia to the industrial partners via secondments."

Further achievements included analysis of the SMEs' potential for developing experience staging opportunities, and development of plans for implementing such opportunities. The five-member consortium ran over four years to April 2014.

The group studied and selected options for transforming each SME's services through experience staging. The work also involved three longitudinal studies, plus an online customer satisfaction survey.

Project research yielded two published journal papers, with a further five under review, plus two book chapters and a report. Project members gave numerous presentations.

The results of STAGEIT inspired European SMEs to incorporate experience staging into their strategies.


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STAGEIT

- Coordinated by Reykjavik University in Iceland.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/159921_en.html
- Project website: http://en.ru.is/rusb/crie/stageit/

ACCENTUATING THE POSITIVE IN NEWS MEDIA

Experiments on the way emotion-eliciting news can change citizens' political perceptions and behaviour offer novel understanding. They indicate that positive emotional cues in the news create better emotional reactions and generate a positive influence on citizens' political behaviour.

News media is known for having an effect on people's emotions and behaviours. Emotional cues present in the writing function as a catalyst and can increase the message's persuasiveness. This is particularly the case in EU news coverage during a time of economic crisis. Despite this, there have been only a few studies covering the effect of emotions on individuals and behaviour. Until just recently there were no studies on the role of emotions in the news media across countries and political issues.

The EU-funded project EMOCITI (Europe for the Hearts and Minds: The Role of the News Media and Emotions in Creating European Citizens) used survey experiments to examine if and how news stories that provoke emotions created changes in the political perceptions and behaviours of citizens. The surveys had a different scope according to the country. In the United Kingdom, the range of positive and negative emotions concerning news articles about elderly care was examined. As a comparative aspect, the second experiment was conducted in the United States. It tested emotions with temporal orientation such as articles mentioning relief and anger versus those of hope and fear on the topics of elderly care and gun control.

Findings indicate that positive emotions are more likely than expected to predict media effects. Furthermore, after being exposed to a news article, respondents registered an emotional reaction that led to changes in opinions and behaviours.

"Findings indicate that positive emotions are more likely than expected to predict media effects."

A wide range of emotions was tested and an extensive list of moderator variables was used. The data collected can be useful in creating a typology of emotional cues. Results are also valuable for further developing the

measurement of emotions and emotional traits in survey experiments.

EMOCITI's work will contribute to the further theoretical integration of emotions into the field of political communication. It can be further used as a roadmap for the inclusion of emotional cues in political campaigns in the EU and elsewhere.


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EMOCITI

★ Coordinated by the London School of Economics and Political Science in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159822_en.html
★ Project website: http://emociti.wordpress.com/

BOOSTING RESEARCH ON GLOTTALISATIONS

Glottalisations — sounds created by the closing and sudden opening of the vocal cords — impact language learning, teaching and training. An EU initiative investigated glottals in German and Czech speakers of English.

In the German and Czech languages, glottalisations are common before words with initial vowel sounds and are also important in linking words. In the English language, however, they are less common.

Overall, the aim of the EU-funded GECZENGLOTT (Glottalizations in German and Czech English) project was to analyse glottalisations in German English and compare them with various other language productions. Activities were carried out based on previous research conducted on glottalisations in Czech English.


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A speech database of German-accented English was initially set up and the recorded signals used in automatic speech recognition experiments.

Project members analysed glottalisations prior to word-initial vowels in German English and compared them to Czech English and British English.

Experiments were conducted with German and English listeners to investigate the effect of glottalisations on word recognition by Germans and then compare them to Czech and English natives. Experiments also analysed the impact of glottalisations on the perception of foreign accents by native English speakers.

Additional tests examined the perception of pitch in glottalisation by native speakers of German and English. To validate outcomes, experiments were also carried out with native speakers of Chinese, Macedonian and Swedish.

Results showed that glottalisations influence the perception of accentedness — the extent to which a listener judges second language speech that differs from the native speaker norm. This finding led to the development of a new method to guide non-native speakers in dealing with such pronunciation issues.

GECZENGLOTT has enriched the body of knowledge on glottalisations, which will advance research in second language acquisition, speech and phonetics. Second language teachers and learners stand to benefit from the outcomes.

GECZENGLOTT

★ Coordinated by the Technical University of Dresden in Germany.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159816_en.html
★ Project website: http://wwwpub.zih.tu-dresden.de/~bissiri/GeCzEnGlott.htm

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ENERGY AND TRANSPORT

HELP FOR RAIL INDUSTRY ON CUTTING POLLUTANTS FROM DIESEL ENGINES

An EU-funded project has demonstrated that it is economically and technically challenging for rail operators to replace or retrofit older diesel locomotives to meet tighter emission limits on pollutants. Market incentives should be provided to speed up the switch to new, cleaner technologies, the project recommends.

New EU rules have set stricter limits on the exhaust emissions that can be emitted by diesel locomotives. The change tightened limits for two types of pollutants — particulate matter and 'nitrogen oxides' (NOx).

The rules address a health risk, and an environmental one. Particulates can enter into the lungs, while NOx can turn into smog in reaction to sunlight. For some, such as those suffering from severe asthma, the risk from both can be life-threatening. On average, about 20% of Europe's current rail traffic is hauled by diesel locomotives. Some EU countries — such as the UK, Greece, Estonia, Latvia and Lithuania — are highly dependent on diesel traction.

To help rail companies comply with the new rules, the EU-funded CLEANER-D (Clean European Rail - Diesel) project field-tested new filtering technologies and engines in Germany, France and Italy. The tests and research fed into guidance for rail companies and policymakers on the best way forward.

'The trials showed it was feasible to retrofit existing locomotives with configured and compliant engines,' says project spokesperson Jan Steinkohl of the Belgium-based Union of the European Railway Industry (UNIFE). 'However, the most efficient way for industry to meet the target is to renew the fleet — speed up the replacement of non-compliant diesel locomotives with newer ones.'

Locomotive tests

The project, which ended in January 2014, conducted field trials of three existing locomotives retrofitted with cleaner technologies. The aim was to develop and improve on emission-reduction technologies and determine their impact.

One test involved retrofitting a 40-year-old freight locomotive with a prototype diesel engine developed by project partner MTU Friedrichshafen in Germany. The engine was equipped with emission-reduction technologies and connected to a particulate filter.

The locomotive had to be adapted to fit the new engine and emission-reduction technologies. Germany's Deutsche Bahn, a project partner, tested the locomotive on its regular freight service from January 2012 to May 2013.

In parallel, project partner SNCF, France's national railway company, carried out another field trial of a shunting locomotive installed with a particulate filter system. 'Retrofitting old locomotives is not always possible,' says Steinkohl. 'However, the tests showed that when done on these particular locomotives, retrofitting can contribute to reaching the EU's emission targets.'

In the third field trial, a prototype engine developed by project partner Caterpillar was successfully integrated in a new diesel-electric locomotive, along with an exhaust gas recirculation system and a particulate filter.

Project partner Trenitalia tested the locomotive in Italy, hauling heavy freight from September 2013 to January 2014. The trial allowed the project to evaluate the performance of the new emission-reduction technologies.

"The locomotive design had to be modified to reduce weight to comply with rules on axle load limits."

The project found that installing the new compliant engines resulted in a significant weight and space increase. For example, the test locomotive required a 20% larger cooling plant and a new roof hatch. The locomotive design had to be modified to reduce weight in other areas to comply with rules on axle load limits.

'These field tests confirmed that cutting emission levels with current technologies meets EU requirements,' says Steinkohl. 'However, the technical and economic feasibility of retrofitting has to be carefully evaluated.'

Even if solutions were available from the engine manufacturers to comply with new emission regulations, the trial in Italy showed that several years might be required before the new compliant vehicles can enter into service, he adds.

'Cutting emission levels with current technology tends to lead to heavier and bigger propulsion units — increasing weight and potentially fuel consumption,' says Steinkohl. 'Even if solutions were available from the engine manufacturers to comply with new emission regulations, the trial in Italy showed that several years are required — due to the process of getting approval from regulatory authorities — before the vehicles can enter into service.'

Industry guidance

The project's trials and scientific research fed into recommendations on the most feasible way the rail industry could achieve EU emission targets for diesel engines.

However, policymakers should also provide incentives for rail operators to replace older diesel engines with the new, cleaner freight locomotives, adds Steinkohl. One such incentive would be a subsidy to encourage industry to scrap and replace older, more polluting locomotives. Without incentives, many diesel locomotives might be taken out of service without being replaced.

Such decisions could result in a lack of capacity, and some customers might shift from rail to road. This would have a larger environmental impact than maintaining capacity, the project found.

'Emerging technologies and hybrid engines could help to reduce diesel emissions even more, but industry needs time to evolve these to commercial applications,' concludes Steinkohl.

CLEANER-D

- ★ Coordinated by UNIFE in Belgium.
- ★ Funded under FP7-TRANSPORT.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=34676
- ★ Project website: http://www.cleaner-d.eu/

AIR PUFFS IN THE RIGHT PLACES

Although the jet engine provides the thrust for flight, lift is the job of the wings thanks to their aerodynamic shape. 'Active flow control' (AFC) is the next rung on the wing's evolutionary ladder.

The aerospace community is working hard on numerous advanced wing concepts that enhance lift and decrease turbulence, such as high-lift devices and natural laminar flow designs. AFC refers to technologies that intelligently change the flow of air over the wing's surface to enhance aerodynamics.

The Clean Sky consortium is in charge of Europe's most ambitious aerospace research programme yet. An important pillar of the programme is smart high-lift devices integrated on trailing edge wing flaps. The EU-funded project AFCIN (Structural designs and tests for integration of active flow control concepts on a trailing edge high lift device) was launched to investigate AFC and, in particular, pulsed air in this context.

Scientists found a solution using the AFC actuator developed in a parallel project (FloCoSys). The AFC features facilitated a significant reduction in outer wing flap dimensions relative to baseline design. This also reduced thickness and thus internal space for devices and installations, increasing the technical challenge.

In the end, AFCIN employed a multispar concept for most of the flap where the spar is the main structural member. The unusual and innovative multispar design of the flap was not only easier to manufacture but it also created space. The space was used for

installation of the plenum or pressure chamber containing the pressurised air for the AFC device.

Material specimens, including carbon fibre-reinforced composite plates, have been manufactured and subjected to static and fatigue testing under various loading conditions.

"The AFC features facilitated a significant reduction in outer wing flap dimensions relative to baseline design."

Even with very high strain, the disturbed plate design performed quite admirably. A demonstrator with a 2-metre span was also tested, and in addition a full-size mock-up demonstrator of a section of a wing flap was given to the Clean Sky project leader for testing.

AFCIN integrated AFC into a trailing edge outer wing flap to enhance aerodynamic performance and lift. The system enabled a significant reduction in the size of the wing flap. Better lift with less weight could potentially translate to lower fuel consumption and emissions. If used for steeper lift-off and landing, the technology could also reduce the noise associated with these activities for even greener flight in the near future. AFCIN has brought the technology one step closer to full integration and in-flight testing.

AFCIN

- Coordinated by the University of Brunswick — Institute of Technology in Germany.
- Funded under FP7-JTI.
- http://cordis.europa.eu/result/rcn/159820_en.html

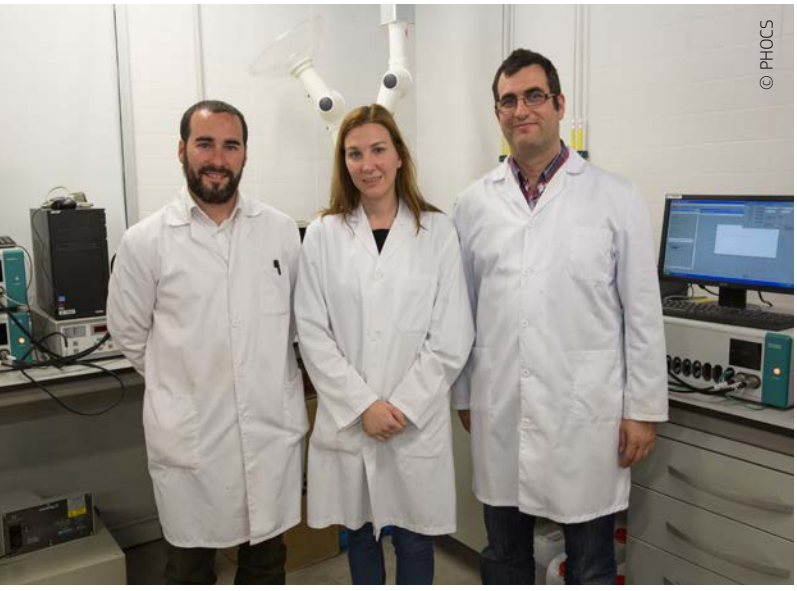
MAGAZINE EXCLUSIVE

NEW DEVICE TURNS SUNLIGHT INTO HYDROGEN

A team of EU-funded scientists have developed a novel, hybrid device capable of creating hydrogen from water and sunlight.

Commonly referred to as the 'hydrogen economy', the vision of hydrogen as a low or zero-carbon energy source for the likes of transport and heating is considered to be one of the most promising solutions in the fight against climate change. However the conversion process is still in its early stages: to this day natural gas remains the most efficient raw material for hydrogen production, which also means that the typical hydrogen fuel cell car still generates CO_2 emissions.

For these emissions to hit rock bottom, renewable electricity sources have to be used instead. Several alternative production methods are currently being explored by researchers across the world, and the PHOCS (Photogenerated Hydrogen by Organic Catalytic Systems) team is in the race: since December 2012, the seven-strong consortium has been trying to combine organic and inorganic materials to build a hybrid, efficient and low-cost photoelectrochemical system for hydrogen production.


© PHOCS

The best of both worlds

Recently researchers from the Photovoltaic and Optoelectronic Devices Group at Jaume I University in Spain have advanced the project's research significantly. They successfully developed a photoactive device combining organic and inorganic materials that allows for the conversion of water into hydrogen using only sunlight.

'The process of converting sunlight into hydrogen takes place through a sequence of different steps,' says Sixto Giménez who coordinated this study as part of the broader PHOCS work packages. 'First, there is the photovoltaic conversion of light into charge carriers, which takes place in the organic semiconductor material. These charge carriers are asymmetrically extracted to both contacts: the holes (h+) are extracted to the external circuit of the device and then to a counterelectrode, where they oxidise some species in the solution. On the other hand, the electrons (e-) reach the interface with the aqueous solution, where they convert protons (H+) into H_2 gas through the electrochemical reaction 2H+ + 2e- -> H_2 (gas).'

The groundbreaking nature of this project lies in the use of these organic semiconductors. Whilst the production of hydrogen from sunlight has been investigated for some time now, the process has indeed proved challenging, costly and presented rather low conversion efficiency. Organic semiconductors have equally been considered for their greater versatility, efficiency and lower cost compared to inorganic ones, but they posed stability problems when in contact with water. They corrode, a problem the project team managed to overcome by combining organic and inorganic materials.

'We managed to produce hydrogen for a total of three hours, demonstrating a stability of organic materials that had not been reached so far,' Giménez explained. To do this, the team placed a physical barrier made of compact layers of nanometric titanium oxide between the photovoltaic part and the catalyst that provides the hydrogen generation reaction. In addition to acting as a barrier between the water and the photovoltaic part, the material also

electrically connects the latter with the device's platinum catalyst.

Objective 2020

The team points out that the intrinsic advantages of organic semiconductor materials in terms of synthetic versatility, mechanical flexibility and light weight all make this newly-developed technology an excellent candidate for portable applications where both the production of solar fuels and their consumption in a fuel cell can be integrated. However, there is still some way to go before the project ends in November 2015.

Now that the researchers better understand the physico-chemical mechanisms that operate organic devices and have developed their own, the next step will be to continue working on improving its performance — especially its energy conversion efficiency.

'At present, we have simply demonstrated the validity of the concept but we are still far from technological applications,' stresses Prof. Juan Bisquert, who actively participates in this research. 'Our goal before the end of the project is to achieve a device with higher efficiencies (the technological goal is 10% solar to fuel efficiency) and durability (the technological goal here is 20 years). To this aim, the key point is bringing together the expertise of the different partners of the PHOCS project to achieve an integrated device. An optimistic forecast is 2020 if we can solve the main technical problems related to the efficiency and durability of the device.'

Along with steam reforming, sunlight to hydrogen conversion is a major source of hope for hydrogen enthusiasts. Experts in techno-economical assessment predict that the future implementation of solar fuel technology will depend on the feasibility of efficient and durable devices targeting a cost of approximately EUR 1.80 to EUR 3.60 per kg for dispensed H_2, based on the cost analysis of steam reforming. Low-cost materials and synthetic strategies will be key to achieving this goal, and the PHOCS team is well placed to be first in line.

The PHOCS project is coordinated by Dr Maria Rosa Antognazza, researcher at the Centre for Nano Science and Technology in Milan. Seven partners from five countries are taking part in the project, including research centres, public universities and Italian oil company ENI.

PHOCS

- Coordinated by the Italian Institute of Technology (IIT) in Italy.
- Funded under FP7-ENERGY.
- http://cordis.europa.eu/project/rcn/105961_en.html
- Project website: http://www.phocs.eu/

SOFTWARE FOR DRIVERLESS VEHICLES

An EU-funded team has developed software to control and coordinate autonomous vehicles. The modules allow groups of vehicles to communicate with a central station, facilitating the vehicles' smooth flow in traffic and maintenance of safe distances.

Driverless vehicles, also known as autonomous vehicles, have been proposed as a solution to road congestion and safety issues. Such vehicles first need effective software control and decision-making systems.

The EU-funded DBCAR (Decisions and behaviors for cognitive automobiles research) project aimed to develop a system allowing groups of several vehicles to coordinate their trajectories. Such coordination was intended to maintain safe distances between vehicles, and to improve the flow of vehicles in traffic. The project ran between May 2012 and May 2014.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"Testing was initially conducted for cooperation of two vehicles, then modified to accommodate any number."

Team members began with an extensive literature review concerning the coordination of the vehicles, trajectories. As a result, the researchers chose the solution whereby autonomous vehicles are coordinated from a central agent. Hence, they developed the coordination software for the central agent and two software modules to interact with the control software of each vehicle. One module collected information from the vehicle database and relayed it to the central

agent; the other received the processed trajectories from the central agent and overcame the normal outputs of the vehicle controller.

Using information from all autonomous vehicles in a certain area, DBCAR developed cooperative trajectories for each vehicle, which were sent to the vehicles. Testing was initially conducted for cooperation of two vehicles, then modified to accommodate any number.

The research concluded that exploring all possible combinations is not feasible, and that alternative methods for optimal searching should be used instead. Testing showed the particle swarm optimisation method to be applicable, and the method can be expanded relatively simply to control numerous vehicles.

DBCAR produced methods for simultaneously controlling groups of vehicles through intersections and around other obstacles, increasing safety by maintaining a minimum safe distance. The broader outcome was methods for achieving fuel savings and reduction in travel time.

DBCAR

★ Coordinated by the Karlsruhe Institute of Technology in Germany.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159897_en.html

MODELLING AIRFRAME NOISE

Although most people think of jet engines when aircraft noise is mentioned, airframes contribute significantly to noise generated by modern aeroplanes. An innovative and efficient modelling suite is pointing the way to new low-noise designs.

Reduction of aircraft noise is a major challenge for the aerospace industry and one of the main pillars of the EU's ambitious Clean Sky research programme. 'Computational aeroacoustics' (CAA) analysis is an important design tool for development of low-noise concepts.

One of the most difficult aspects is modelling near-field turbulence. Software that resolves turbulence is useful, but computationally heavy and time consuming. EU-funded scientists set out to exploit the benefits of computationally efficient 'Reynolds-averaged Navier–Stokes' (RANS) equations for CAA in the project CALAS (Computational aero-acoustic analysis of low-noise airframe devices with the aid of stochastic method).

Analysis focused on two low-noise concepts for high lift and main landing gear configurations of regional aircraft. The team developed a stochastic source modelling method for broadband noise generation based on steady RANS computations using computational fluid dynamics techniques. The same method was used to formulate the turbulent flow-generated noise source, which was then incorporated into the CAA analysis to predict its contribution to far-field noise.

The stochastic method was first tested and demonstrated in CAA analysis of the baseline configuration of a high-lift wing concept (flap side-edge or FSE double-flap wing). The baseline results were then compared to results on a low-noise FSE configuration with an add-on wing tip fence. Outcomes demonstrated that the low-noise configuration enables an overall far-field noise reduction of 3–7 'decibels' (dB).

Scientists then analysed a baseline main landing gear configuration and three low-noise concepts. Only the acoustic liner patched on the rear wall of the landing gear bay was able to reduce noise compared to baseline. This configuration did so by about 1.8 dBA. dBA refers to so-called A-weighted sound levels often used for regulatory noise limits. This sound level scale is potentially better correlated with the relative risk of noise-induced hearing loss.

"Analysis focused on two low-noise concepts for high lift and main landing gear configurations of regional aircraft."

The CALAS project demonstrated the effectiveness of the stochastic noise source modelling method based on cost-effective RANS equations in industrial consideration of broadband noise for CAA. The methods will support rapid development of low-noise aircraft concepts by the European aeronautics industry. Within the current project, insights gained regarding low-noise configurations point to important design issues for future concepts.


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CALAS

★ Coordinated by the Swedish Defence Research Agency in Sweden.
★ Funded under FP7-JTI.
★ http://cordis.europa.eu/result/rcn/159780_en.html

ENVIRONMENT AND SOCIETY

SCRUTINISING SNOW AND ICE FROM SPACE

The melt rate of Europe's snowy peaks and glacial lakes can have a huge impact on both daily activities and planning in many countries. EU-funded researchers have developed applications that use satellite data to tell them just that, in close to real time.

'Snow and glaciers are not just about tourism,' says CRYOLAND project coordinator Thomas Nagler of engineering company ENVEO, explaining why monitoring both is indispensible. They are important water resources, especially in spring and summer, when snow and ice melt, trickling down to reservoirs. Snow and ice are also indicators of climate change.

On a daily basis, snow and ice updates are needed by stakeholders as diverse as hydropower companies, hydrological and meteorological service providers, climate monitoring bodies, environmental agencies, road, rail and river authorities, geotechnical construction companies, avalanche warning centres and ecologists.

To provide these potential users with the information they need, the EU-funded CRYOLAND (GMES service snow and land ice) project has developed a process to first receive data from a network of satellites, combine it with ground-based measurements, and then make this data accessible in customised online applications.

CRYOLAND will ultimately use data from the EU's Copernicus space programme — a fleet of satellites and ground stations being developed to monitor the environment. In the meantime, the team has been relying on other satellites. 'Since the launch of Sentinel-1 in April 2014 — the first of a series of European Sentinel satellites — we have had radar data of an excellent quality and extended temporal and spatial coverage,' he says.

The satellite data is processed applying algorithms and automated techniques developed by the CRYOLAND team, which calculate — for example — the extent of snow coverage and snow melt area.

Real-time information

What makes the applications so precious is not only their accessibility and accuracy, but also the speed with which they make information available. The CRYOLAND system continuously checks for new satellite data, downloads the data and begins generating the applications.The product — be it a snow coverage map or details of lake ice — is then ready for customers within a few hours after image acquisition. The information is therefore available when those who need it begin checking early the next morning. The goal is to have an automated system by the end of the project in January 2015, and the team is well on track.

Users benefit from direct access to the very specific information they need, avoiding the need to download enormous files containing only small amounts of relevant data.

"CRYOLAND has produced daily 'snow extent' maps for Europe from 2000 until the present day."

Some 60-70 user organisations have been involved in the project since the beginning. They have helped define products and services, supplied feedback on various prototype products and tested the applications over the last two winters. This feedback helps to optimise algorithms and services, to ensure the services deliver the information needed. The project is now in the demonstration phase, providing automatic services for snow, glaciers, lakes and rivers.

The significance of the CRYOLAND applications has not gone unnoticed. The

European Space Agency, the European Environment Agency and commercial companies are all following the project with interest, while talks are underway on a follow-up project that Nagler hopes will extend his team's snow and glacial services.

From the Alps to the Himalayas

In Europe, users of glacier data are primarily based in Alpine regions or Scandinavia. But the appeal of the applications extends to further afield. In South America and the Himalayan region, glacial lakes are of particular interest. They are often in very remote regions, making them difficult to monitor. But remoteness doesn't diminish the impact on people and infrastructure further down the valley if the ice melts faster than usual — or if the water supply dries up.

In addition to providing immediate information on water supply and potential hazards, monitoring snow and ice can also provide valuable insights into climate change. 'Snow and glaciers are very sensitive to the climate,' explains Nagler. CRYOLAND has produced daily 'snow extent' maps for Europe from 2000 until the present day. How snow and glaciers retreat from year to year is important for climate scientists, and many are poring over the CRYOLAND data.

All applications and products can be accessed via the project website. Access is currently free of charge, although Nagler hopes that the project will one day be able to make money from its results.

CRYOLAND
- ★ Coordinated by ENVEO in Austria.
- ★ Funded under FP7-SPACE.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=34537
- ★ Project website: http://www.CRYOLAND.eu/

IMPROVING PREDICTIONS OF CLIMATE CHANGE IMPACTS

An EU study has addressed the weaknesses of 'Integrated assessment models' (IAMs) in predicting the economic effects of climate change. The project revealed large uncertainties about the effects in several regions, and created more accurate modelling techniques.

IAMs have been popular in environmental and atmospheric sciences since at least the 1980s. However, the models' many weaknesses, including simple damage functions, amount to vagueness about the impacts of climate change.

The EU-funded CLI-EMA (Climate change impacts — Economic modelling and assessment) project addressed the shortcomings of IAMs. The single-member project ran for three years to April 2014. Beginning with a literature review, the work was then scheduled to incorporate current findings into more detailed models of climate impacts. One aim was to accurately predict damage from future climate change. Additionally, the team planned to provide a revised IAM for analysing the cost-benefits of stabilising greenhouse gases at a relatively low level.

Project work made substantial contributions, including estimating the effect of climate change on agriculture in Brazil, Europe, Italy and the United States. The study also examined evidence of climatic thresholds, beyond which there could be significant damage to agriculture. The project was also the first to determine the impact of climate change on migration incentives for African rural households using cross-sectional methods.

Other major results include a series of papers which made the following conclusions: models of the impact of climate change on agricultural economics that control the mean seasonal temperature and precipitation are superior to those using degree-days parameters; American land values will not suddenly collapse at a temperature threshold, but will rather decline gradually with increasing temperature; and Brazilian agriculture may be severely damaged by climate change. For example, recent use of heat-tolerant soybean varieties increased productivity but also the overall vulnerability to change.

Europe may experience agricultural losses from climate change. This will be worse in southern Europe, while northern Europe may benefit from climate change. Migration patterns of rural households in Nigeria and Ghana may be only modestly affected. There is a large degree of uncertainty surrounding climate scenarios at regional levels; the data available may not represent all possibilities or reflect the true complexity.

Given the uncertainties, the project's new research methods and impact estimates may be helpful to researchers and policymakers.

CLI-EMA yielded more accurate modelling of the agricultural and economic effects of climate change.

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CLI-EMA
- ★ Coordinated by FEEM in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159895_en.html

WHY DRAGONS LOSE COLOUR WITH AGE

Oxidative stress, or damage due to free radicals, is a hot topic in science due to its role in cancer, infertility and ageing. Recently, EU-funded researchers conducted a unique animal study that sheds light on the process.


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The project, known as ROSELH (Reactive oxygen species and the evolution of life histories), was one of the first attempts at studying two different species in both their natural setting and the laboratory. The species studied were the Australian painted dragon and a zebra finch (a small songbird).

The first was chosen due to its short lifespan, high reproductivity and distinct colouration (which diminishes with age). These characteristics allowed researchers to study the age-related effects of reproduction and immunity.

They found an association and a positive correlation between colouration and free radical exposure. In addition, higher testosterone levels denoted an age-related colour loss in males; in females, reproduction increased metabolic activity, which in turn increases free radical levels.

To further investigate the influence of free radicals during early development on physiological and behavioural changes in adulthood, researchers studied the zebra finch. Their aim was to confirm the formation of long-term free radical characteristics.

Exactly how free radicals influence organism health and evolution is still in contention. However, this project has provided new insights into the role of oxidative stress in evolutionary biology, opening up new avenues for interdisciplinary research.

ROSELH
- ★ Coordinated by the University of Lunds in Sweden.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159834_en.html

GENES CONTROLLING MATE CHOICE

The genetics underlying sexual attractiveness and mate choice in fruit flies may reveal how the evolution of mate preference creates different physical traits between the sexes.


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In sexually reproducing organisms, sexual display traits are features that have evolved to make an individual alluring to a member of the opposite sex. Since males and females of a species share many of the same genes, genetic conflict may arise when mate preferences differ on a shared trait.

This conflict is resolved by sexual dimorphism, where sex-specific genetic variation allows each sex to separately evolve optimum physical characteristics for mate selection. There are constraints, however, on how far these traits can evolve without also affecting other traits that may be genetically linked.

The EU-funded AEMMPN (Adaptive evolution of mutual mate preferences in nature) project used the Drosophila fruit fly to study the genetic basis of mate preference.

Drosophila individuals recognise and choose mates by detecting mating pheromones and through other sexual displays such as a courtship dance and a wing song. AEMMPN analysed mating pheromones in 4 000 individuals to identify the distribution and frequency of genes responsible for male attractiveness, and hence mating success.

After carrying out over 2 000 mating trials, researchers found that males and females do not respond to the same sexual cues. Male mate choice is therefore not correlated with female mate choice, suggesting that male and female preferences are genetically distinct traits that evolved separately.

Since an individual's traits are determined by a combination of its environment and genes, AEMMPN also looked at the effect of diet on mate choice. Unlike the sexual display traits, genes underlying dietary preference were shared by both sexes and had a large influence on sex-specific fitness. A possible reason is that an optimal diet maximises the ability to reproduce, and therefore genes controlling dietary preference are passed on to offspring.

These findings have broadened our understanding of how and why mate preferences differ at the genetic level. This will contribute to the work of many other evolutionary biologists, behaviourists and molecular ecologists.

AEMMPN
- ★ Coordinated by the University of Lunds in Sweden.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159815_en.html

TREES ARE MILLENNIAL TEMPERATURE GAUGES

Scientists have conducted climate reconstructions over millennia using the isotope signals stored in tree rings.

Finding evidence that describes past, long-term climatic changes is key to understanding the future impacts of climate change on ecosystems. This data can help unravel the natural causes and human influences behind temperature shifts and help the EU prepare for potential environmental disasters.

The EU-funded EU-ISOTREC (Climatic and environmental changes in the Eurasian Subarctic inferred from tree-ring and stable isotope chronologies for the past and recent periods) project aimed to describe the climate changes, and the physiological response of trees to environmental changes, during current and past geological periods. This was done using traditional methods combined with modelling and analysis of tree-ring width, density and isotope signals, which hold information about large-scale temperature patterns.

Scientists found that the current rate of warming in the Siberian north has occurred before, millennia ago. However, they found global warming has had a greater impact on the forest ecosystems in the northern parts of central Siberia than in north-eastern Siberia.

Furthermore, during recent decades, the trees have responded physiologically to a water shortage, and this is expected to continue increasing along with regional temperatures. Consequently, project research suggests these trees will experience severe drought stress and be exposed to increased fire events as well as insect attacks.

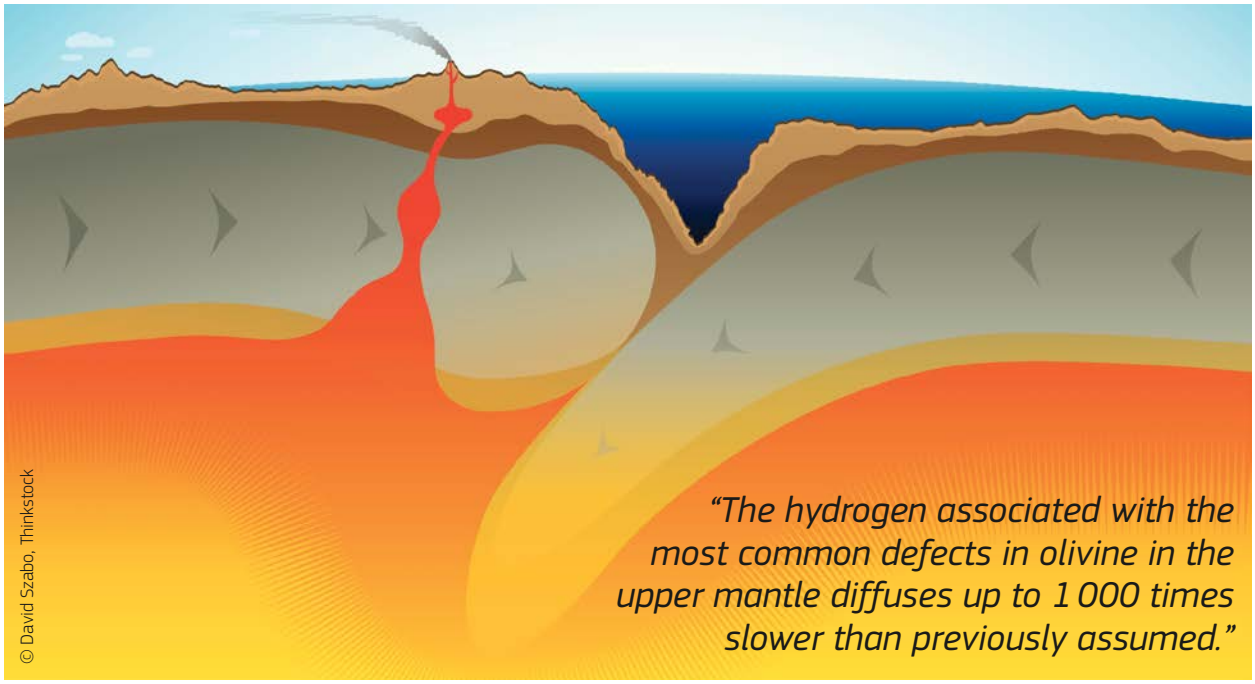
These findings could be used as input for tools designed to help develop effective strategies for managing Russian forests. Documenting the management decisions in this region means that the research could also be used as a European case study for managing large-scale impacts of climate change.

"Scientists found that the current rate of warming in the Siberian north has occurred before, millennia ago."

EU-ISOTREC

- ★ Coordinated by the Sukachev Institute of Forest in Russia.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159899_en.html

HYDROGEN DIFFUSION IN THE EARTH'S INTERIOR



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"The hydrogen associated with the most common defects in olivine in the upper mantle diffuses up to 1 000 times slower than previously assumed."

Although the Earth is a rocky planet, many aqueous dynamic processes take place beneath its surface making it unique among terrestrial planets. New insight into the role of fluids in properties of materials is directly relevant to earthquakes and volcanic eruptions.

Subduction zones are geological regions in which two tectonic plates (pieces of the Earth's lithosphere) violently collide, causing one of them to sink into the Earth's mantle under the other. In general, movements of the oceanic lithosphere (crust and upper mantle from the oceans) facilitate incorporation of water into hydrous minerals. During subduction, some of these hydrous minerals are partially dehydrated, creating a fluid phase.

Some of the water goes back up to the Earth's surface and some is transported to the deep mantle by 'Nominally anhydrous minerals' (NAMs). The EU-funded project HISLA-DR (Hydrogen incorporation in subducting

lithosphere after dehydration reactions) set out to explore the poorly understood mechanisms of water transfer to NAMs.

Scientists first collected new data on hydrogen diffusion into NAMs, particularly olivine. Lab experiments exploiting well-constrained hydrous defect chemistry were followed by a collection of rock samples from high-pressure metaperidotite (e.g. from the Eastern Alps). Analysis of hydrogen content in NAMs from the field samples constitutes the most complete data set of water content in natural peridotites from subduction zones.

Experimental evidence showed that diffusion of hydrogen in the olivine lattice could be either the fastest of any other species or orders of magnitude slower. Scientists have linked the rate to defects in which hydrogen is bound. The hydrogen associated with the most common defects in olivine in the upper mantle diffuses up to 1 000 times slower than previously assumed.

Samples obtained from the Alps and data from laboratory experiments demonstrate preservation of water for long time periods and correlation of hydrogen content to temperature and pressure. Both of these support the observed slow hydrogen diffusion coefficients. Combined field and lab data enable for the first time a quantitative evaluation of maximum water capacity in NAMs in subduction zones, suggesting that the mantle wedge acts as a water reservoir.

Subduction zones are the most geologically active regions on Earth, playing a critical role in seismic events and volcanic eruptions. HISLA-DR has provided profound insight into dynamic aqueous events in these regions, filling an important gap in knowledge and providing insight relevant to hazard prevention.

HISLA-DR
★ Coordinated by CNRS in France.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159875_en.html

BIOSENSORS FOR ENVIRONMENTAL MONITORING

New-generation biosensors adapted for a range of different targets are set to raise the standard of environmental monitoring.

A biosensor is an analytical device that combines a biological component with a physical detector for identifying or quantifying specific compounds within a sample. The biological selective element, for example an antibody or enzyme, usually has high binding affinity and selectivity for a particular analyte (the substance being analysed).

In the most common biosensors, a biological element that has been immobilised on a solid surface binds to a target analyte within a sample mixture. This interaction is measured by a special transducer, which converts the biochemical signal into a measurable electrical signal that is proportional to the analyte concentration.

The EU-funded BIOMONAR (Biosensor nanoarrays for environmental monitoring) project developed a new generation of sophisticated biosensors for monitoring environmental pollutants and pathogens. These combine the advantages of existing sensor systems with an unrivalled flexibility for a multitude of different targets.


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BIOMONAR developed three different sensor platforms consisting of a solid surface, a lipid vesicle or a living bacterial cell, each containing a common biological sensor.

For the biological component, researchers chose a bacterial protein called periplasmic binding protein, which interacts strongly with target molecules via a specific binding pocket. Since the binding pocket's specificity can be tailored to suit whichever target molecule scientists want to detect, BIOMONAR's biosensors have potentially unlimited sensing capability.

This strategy will support EU environmental policy by selectively and sensitively detecting a panel of target compounds. In particular, pollutants and pathogens can be identified in complex environmental mixtures.

"BIOMONAR developed three different sensor platforms consisting of a solid surface, a lipid vesicle or a living bacterial cell, each containing a common biological sensor."

BIOMONAR
★ Coordinated by the University of Southern Denmark.
★ Funded under FP7-KBBE.
★ http://cordis.europa.eu/result/rcn/159805_en.html
★ Project website: http://www.sdu.dk/Om_SDU/Institutter_centre/fysik_kemi_og_farmaci/forskning/forskningsgrupper/raewyn_m_town/biomonar

IT AND TELECOMMUNICATIONS

WALK-MAN MAKES ENGINEERS PROUD AT DARPA ROBOTICS CHALLENGE

Do you remember iCUB, the open-source, EU-born, baby-inspired robot which has been making headlines since 2004 for its capacity to mimic human behaviours? Its prolific inventors have come up with yet another game-changing robot, capable of performing a task as advanced as driving a car.

Nowadays there seems to be a robot for doing just about anything, from dancing to playing ping pong or the trumpet. But as technology evolves, engineers are now trying to develop a new generation of robots capable of helping in situations where humans can't. The WALK-MAN robot was built for this very purpose, to seamlessly operate in environments damaged by natural or man-made disasters.

Jointly created by the Italian Institute of Technology, the University of Pisa, the Swiss Federal Institute of Technology of Lausanne, the Catholic University of Louvain and the Karlsruhe Institute of Technology, the WALK-MAN robot displays a range of unprecedented skills in robotics. A project video published last week shows how the robot's dexterity and strength allow it to make Shaolin-inspired gestures, turn heavy valves, open doors and drive a car. But that's not it: WALK-MAN can of course walk, crawl over uneven terrain, move heavy masonry or manipulate pneumatic drills — and it can do all of this autonomously or by means of a remote control. The robot can in fact work autonomously for an hour thanks to its embedded battery.

To achieve this result, the consortium had to bring current walking and locomotion capabilities of humanoid systems to another level. By using its hands, arms, legs, feet, trunk, and making use of surrounding elements such as handrails, walls and furniture, the WALK-MAN robot can walk through cluttered, crowded spaces and maintain its balance as it runs into other objects or people. The robot's hands have also been built with a high sensitivity to detail, with a human-inspired hand design that combines robustness and adaptability to perfectly grasp and manipulate hand tools.

Perception-wise, WALK-MAN's head features a stereo vision system, a rotating 3D laser scanner and a depth camera for 3D mapping and sensing. It also integrates colour cameras which provide it with additional sight of the world around it and facilitate navigation.

The DARPA challenge

Already acknowledged for its innovative aspects, the 1.85 metre, 100 kilo humanoid robot had the challenging task of representing the EU at the US Defense Advanced Research Projects Agency (DARPA)'s Robotics Challenge Finals on 5 and 6 June 2015. The challenge's ultimate goal is to enable future robots, in tandem with humans, to perform the most hazardous activities in disaster zones, thereby reducing casualties and saving lives.

WALK-MAN, which successfully passed the trials of the DARPA challenge in December 2014, did not disappoint although it did not win the contest. The imposing robot was let down by its batteries.

"The WALK-MAN robot can walk through cluttered, crowded spaces and maintain its balance as it runs into other objects or people."

The robot had to face competition from 24 other teams from the US, Japan, Germany, China and South Korea. Team Kaist from South Korea and its robot DRC-HUBO won the contest with $2 million in prize money. The robot showcased the best ability to maneuver in degraded environments, manipulate tools designed for humans and make decisions in partial autonomy based on operator command and sensor inputs, all this while being easy to operate for people with no robotics training.

WALK-MAN

- Coordinated by the Italian Institute of Technology in Italy.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/123037_en.html
- Project website: http://www.walk-man.eu/
- http://bit.ly/1AIvkZK

ANALYSING THE CLOUD

An EU team has developed scalable systems for analysing cloud-stored data. The real-time applications were successfully demonstrated at several large companies, where they were used for network analysis and sensor validation.

A vast amount of information is stored in online cloud systems, which may mean competitive advantage for any business able to analyse it. A lack of suitable software currently makes such analysis difficult, thus Europe may benefit from investing in such technologies.

"The project developed a prototype real-time data stream and complex event processing service."

The EU-funded BI4MASSES (Business intelligence for the masses) project aimed to design and implement scalable cloud analytics software. The undertaking consisted of four phases: introduction of a distributed cloud infrastructure service, data mining and reporting, real-time stream processing and development of applications. The project ran between mid-2010 and mid-2014.


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Team members first designed and implemented a suitable cloud infrastructure onto which several distributed systems data processing tools were installed. Next came design and implementation of a data mining and reporting service, using open-source tools.

Although the work led to several publications, the prototypes could not be expanded to support millions of users as intended. The reason was lack of a sustainable business model, which the project's Principal Investigator and one student overcame by establishing a separate company.

Subsequently, the project developed a prototype real-time data stream and complex event processing service. Lastly, the project created and demonstrated intelligent applications based on the previously developed platform services. The applications were delivered to a variety of large companies; the tools were applied to analysing various kinds of networking logs and validating sensor data.

The project resulted in five Master theses. Three PhD students were continuing studies at the time of the project's closure.

BI4MASSES also yielded new software tools for analysing cloud data for business applications.

BI4MASSES

- ★ Coordinated by Ozyegin University in Turkey.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159912_en.html

BETTER ROBOTICS EXPLOITING VISUAL ATTENTION

The ability to process and utilise strictly visual information during object manipulation regardless of an object's physical traits is critical to next-generation robotics. New technology has removed previous barriers and outperformed competitors.

Many approaches have been proposed, but achieving real-time processing of closed-loop perception-action cycles has necessitated severely simplified system models. This poses a restriction in terms of identifying sensory information of meaning to the task (sensory-semantic communication).

Scientists developed novel methods to build and update a detailed 3D scene representation based on sensory information extracted from the scene in real time. With EU support for the project FASTDEFORM (Real-time understanding of dexterous deformable object manipulation with bio-inspired hybrid hardware architectures), researchers delivered a pioneering system that surpassed the performance of state-of-the-art methods.

FASTDEFORM exploited the massive parallelism of graphics processing units, programmable logic chips that perform rapid computations primarily for the purpose of rendering images, animations or video. Concepts based on visual attention allow for focusing on scene items of interest at a level of abstraction supported by both real-time sensory and prior information.

Researchers achieved significant enhancements in the speed, robustness and accuracy of perceiving and understanding a complex dynamic scene. This was accomplished through real-time

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integration of visual simulation and visual perception on the same hardware.

The highly robust and real-time system operation was demonstrated in three different tasks. These covered manipulation of a large number of rigid objects, manipulation of a complex foldable cardboard brochure and vision-based robot control using feedback from a vision sensor. More information on each is available online.

FASTDEFORM technology provides robotic systems with the ability to perceive and understand complex manipulations of non-rigid and dynamically changing objects. This enables them to move out of the realm of highly constrained industrial settings to novel applications in manufacturing, medicine and domestic environments. It has the potential to usher in a new era of devices exploiting human abilities in support of human endeavours.

FASTDEFORM
★ Coordinated by the University of Granada in Spain.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159873_en.html

MULTIMEDIA MEET NEXT-GENERATION WIRELESS NETWORKS

Communicating multimedia content such as images, audio or video streams has become an integral part of everyday life, for both business and entertainment purposes. An EU-funded project has explored networking problems in delivering multimedia data over emerging wireless networks.

Information is increasingly becoming available anytime and anywhere. Use of mobile technology, especially for video streaming, mobile television, video conferencing, peer-to-peer networking and interactive gaming, has been gaining widespread use over the last few years.


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"The research focused on unequal error protection schemes for reliable multimedia delivery, and design and analysis of multimedia delivery services over LTE and LTE Advanced."

Consuming a major part of network bandwidth, such applications have been considered the main driving force behind next-generation mobile broadband technology. Mobile WiMAX, 'Long-term evolution' (LTE) and LTE Advanced are mobile internet standards that provide sufficient data rates for high-quality mobile multimedia services.

Network coding is a new paradigm in information processing that opens possibilities for improving network performance in terms of throughput, reliability and delay reduction. Despite its potential to increase bandwidth efficiency, wireless communication systems based on network coding are faced with a number of issues in supporting access to multimedia data.

The EU-funded project MMCODESTREAM (Design, analysis and applications of novel information processing paradigms for multimedia transmission in next generation wireless networks) sought to address the challenges associated with designing efficient and scalable network coding schemes for wireless multimedia transmission. The research focused on unequal error protection schemes for reliable multimedia delivery, and design and analysis of multimedia delivery services over LTE and LTE Advanced. Research was also geared toward other novel topics such as coded random access protocols in wireless networks.

Project research has advanced the state-of-the-art in efficient multimedia transmission over next-generation wireless networks. The initiative also resulted in 13 peer-reviewed scientific publications and the presentation of 17 papers at many international conferences.

MMCODESTREAM
★ Coordinated by the University of Novi Sad, Faculty of Technical Sciences in Serbia.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/159922_en.html

© DALI

INDUSTRIAL TECHNOLOGIES

ROBOT WALKER FOR ELDERLY PEOPLE IN PUBLIC SPACES

Elderly people with walking difficulties are often intimidated by busy public places. This has led an EU research project to develop a robot walker to guide them around shopping centres, museums and other public buildings, thus enhancing their autonomy.

Shopping centres, airports, museums and hospitals are the kind of complex and confusing environments where elderly people on the verge of cognitive decline could have difficulties walking around without help. The walking frames they may currently use do not have the flexibility to help them navigate in often-crowded places.

This led researchers on the DALI (Devices for Assisted Living) project to develop a robotic cognitive walker (c-Walker) that can be taken to, or picked up at, the place to be visited, gently guiding the person around the building safely. The device takes corrective actions when the user comes across the type of busy area, obstacle or incident they want to avoid.

'The c-Walker is aimed at providing physical and cognitive support to older adults. It can give them confidence in public environments,' explained Luigi Palopoli, Professor at Italy's Trento University which coordinated DALI. 'The device is full of hi-tech solutions, but the user is not necessarily aware of them. She or he comes into contact with a "standard" walker, with a few additions such as the display or bracelets, and does not need any kind of computer literacy. The robot simply guides them so that they have a nice, safe experience.'

Programming the robot before setting off

Shopping is recommended as a useful way for elderly people to exercise and is viewed as an important activity for

prolonging their autonomous mobility. It also provides them with good opportunities to interact socially. For these reasons, shopping centres were considered by the DALI project to be a typical environment an elderly person would ideally visit. Picking up the c-Walker at the entrance, the elderly shopper selects the profile most suited to them on its simple touch-screen and the shops to visit. The c-Walker then recommends the best course to the user and guides them using visual, acoustic and haptic (tactile) interfaces.

The c-Walker uses different solutions (RFID tags, invisible QR codes, and cameras) to locate itself in the environment. Furthermore, it can connect with remote sensors, such as surveillance cameras, and with other c-Walkers deployed in the environment to gain remote knowledge of the presence of anomalies, crowded spaces or hazards. The device is equipped with brakes and motorised wheels. Haptic armbands tell users when and how to turn. They can also call for assistance if necessary.

DALI has been very much a user-driven project. The scientists spoke with focus groups of over 50 elderly people in Spain and the UK who explained their mobility needs so that features helping them could be incorporated into the robot. The c-Walker was later tested at residential care homes in Ciudad Real in Spain and Trento in Italy. Feedback from these trials was used to design a more advanced prototype.

By basing the design on software rather than expensive mechatronic components, the DALI consortium has been able to bring unit cost down from tens of thousands of euro to around EUR 2 000 per device.

Stepping out through social networks

DALI, funded with EUR 3 million from FP7, ended last October. But now there is a new 3.5-year project, ACANTO, which is developing the c-Walker further. ACANTO, receiving EUR 4.2 million from Horizon 2020, aims to bring c-Walker users together in social networks. 'This will give them more incentive to go places,' said Prof. Palopoli. 'While in DALI we focused on the single user, in ACANTO we are thinking of groups of users who can do things together, such as visit a museum.'

The consortium believes that, by spinning off a company to market the device, or attracting investment from a major technological manufacturer, c-Walkers could be in common use by 2020.

DALI

- Coordinated by the University of Trento in Italy.
- Funded under FP7-ICT.
- http://cordis.europa.eu/result/rcn/164931_en.html
- Project website: http://www.ict-dali.eu/dali/
- http://bit.ly/1KK0d3k

TOWARD DNA-BASED NANOMATERIALS

DNA is an amazing natural polymer that self-assembles into complex 3D shapes. Scientists have demonstrated the ability to control configuration and make them conductive.

Although biotechnologists have been using DNA to produce controlled shapes and molecules for some time, the process got a turbo-boost in 2010 with the demonstration of 'DNA origami'. Scientists showed that they could 'staple' small sequences in place in order to control the complex bending according to a preconceived molecular design.


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"The next step will be to form a customised DNA-polymer hybrid that conducts electricity, a DNA-based nanowire, for nanotechnology applications."

Despite its amazing role in nature, use of DNA in nanotechnology and nanoengineering has been limited because it does not conduct electricity. DNA nanoengineering is now entering a new phase with the possibility of conferring properties such as conductivity to make the molecules truly useful in nanotechnology applications.

Scientists working on the EU-funded project FUNDNAMAT (Functional DNA-based nanomaterials using metal-mediated self-assembly processes) built on the now well-established DNA origami technique. Using DNA as a scaffold, they focused on the creation of conducting nanowires.

The FUNDNAMAT technique exploits well-designed metal fragments with a monomer unit based on a pyrrole,

heterocyclic ring structures commonly used in pharmaceutical chemistry. The fragments are programmed to interact at specific locations of a single-stranded DNA molecule as in the DNA origami technique. The DNA thus acts as a template for self-assembly.

Team members successfully demonstrated correct assembly of the metal fragments along the single-stranded DNA molecule. The proven methodology is currently being optimised. The next step will be to form a customised DNA-polymer hybrid that conducts electricity, a DNA-based nanowire, for nanotechnology applications.

DNA origami made it possible to form more complicated polymers from DNA more quickly and efficiently. FUNDNAMAT has paved the way to using these molecules as scaffolds that can be functionalised to confer properties such as conductivity, paving the way to integration in nano-scale devices.

FUNDNAMAT
- ★ Coordinated by the University of Granada in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159874_en.html

ORGANIC MOLECULES FOR NEW DEVICES

The same molecule found in haemoglobin and chlorophyll could be the basis of tomorrow's optoelectronics and magnetic data storage devices. EU-funded researchers have characterised novel architectures to push the technology forward.


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Voltage sensing is important in many applications and is typically done with conventional electrical devices such as electrodes. Optical sensing of voltage opens the door to a new era of devices. Scientists manipulated molecules involved in electron transfer to develop voltage-sensitive fluorescence within the context of the project VOLTAGE-PROBE (Optical probes for membrane potential via photo induced electron transfer).

Researchers focused on porphyrins, naturally occurring molecules made of four linked heterocyclic groups often with a metal atom at their centre. Porphyrins form many important substances in the body, including haemoglobin — a protein in red blood cells with iron in the centre that carries oxygen. They also make up chlorophyll, the green pigment in plants responsible for absorption of light. These structures also demonstrate unusual magnetic behaviours based on electron spin and could lead to novel organic-based magnetic data storage.

Photo induced electron transfer in monomeric porphyrins has been studied extensively. Very little is known about porphyrin oligomers, molecules made of two or more porphyrin molecules joined together. VOLTAGE-PROBE synthesised porphyrin macromolecules consisting of between one and six porphyrin units covalently linked together. Scientists then used spectroscopic techniques to study electronic properties and electron transfer.

VOLTAGE-PROBE researchers demonstrated that curved p-systems (conjugation formed by the overlap of p-orbitals) have unique electronic properties (spin states and electronic structures) differing from those of their linear analogues. Rigid porphyrin nanorings of six porphyrin units were extensively characterised, providing important insight into electronic structure.

"VOLTAGE-PROBE researchers demonstrated that curved p-systems have unique electronic properties differing from those of their linear analogues."

The team then went on to develop novel synthesis methods for extended porphyrin tubes. Although much attention has been given to other carbon-based nanostructures such as fullerenes and carbon nanotubes, very little is known about porphyrin nanotubes. Scientists investigated their optoelectronic properties, which were found to be closely related to those of nanorings. One small difference was the onset of florescence, which was shifted to the red in nanotubes.

Porphyrin-based organic macromolecules have interesting optical, electronic and magnetic properties, rendering them potentially useful in a plethora of applications. The VOLTAGE-PROBE project synthesised several architectures and characterised their electronic properties, bringing the technology one step closer to rational design of innovative devices.

VOLTAGE-PROBE
- ★ Coordinated by the University of Oxford in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/159825_en.html

SPACE

SHIELDS UP FOR MANNED SPACE EXPLORATION

Thriving settlements on Mars, mining operations on the moon, exploration teams heading out into the universe — humankind may one day be able to establish a presence far beyond its home planet. The EU-funded SR2S (Space Radiation Superconducting Shield) project strives to remove one of the main obstacles by developing a magnetic shield to protect astronauts from radiation in deep space.

SR2S focuses on the use of superconducting magnets to deflect dangerous radiation on manned missions into deep space. It has developed a variety of innovative components and technologies that are light, compact, energy-efficient and reliable enough for such journeys.

The project's advances include cutting-edge superconducting materials, a novel approach to avoiding potentially destructive heat build-up in the magnets, and a powerful system to cool the equipment on the side exposed to the sun.

These breakthroughs are not just important for the future of manned space exploration. They also stimulate innovation here on Earth. Superconductors underpin technologies as diverse as magnetic resonance imaging scanners and particle accelerators.

Deflecting radiation with magnets

The powerful ionising radiation in space is one of the main issues to be tackled if humanity wants to head out into the starry void, says project coordinator Roberto Battiston of Italy's National Institute for Nuclear Physics, who was appointed president of the Italian Space Agency in May 2014. On Earth, we are sheltered — the atmosphere provides radiation shielding equivalent to 3.5 metres of aluminium, in addition to the protection offered by our planet's shadow and magnetic field.

'Astronauts in deep space will receive a hundred times more radiation than on Earth,' Battiston remarks. 'This has not so far been a major limitation for space exploration, because currently astronauts don't stay in deep space very long.' A return journey to Mars, which would involve approximately one year in deep space, would be a different matter entirely.

The concept of a magnetic shield is not new, says Battiston, but prior to SR2S it had never been explored in detail. 'This is the first programme set up to tackle the various challenges of an active shield for space,' he explains. 'One possible approach is to build a magnet that creates a field able to sweep the particles before they get into the craft. Obviously that's a challenge, but at the moment it's the most promising idea we have. SR2S is improving the technologies that are needed for this idea to become a reality.'

Superconductors offer no electrical resistance to electrical currents running through them, meaning these currents can be maintained without access to a power source — an important consideration for applications in space. That said, materials with superconducting properties only display these at very low temperatures, which means that the magnets have to be cooled.

Superconducting magnets are, of course, already widely used. However, at the moment they are too large and too heavy to be of practical use in space flight. SR2S has designed lighter, smaller components and systems based on magnesium diboride, which offers the added advantage of being far less costly than other superconducting materials.

The project has also developed the systems needed to keep these magnets running: powerful cryogenics, an innovative system to dissipate excess energy during transitions from superconductivity to normal conductivity, and an array of light, small pipes that will move heat away from the part of the hull that is exposed to the sun, towards the craft's cooler side.

Mars matters

The project will end in December 2015, but further development is needed to prepare the technology for deployment, says Battiston. He expects this final stage to take 10 to 20 years.

And then, in terms of the radiation shielding, it's all systems go for human exploration of our planetary neighbourhood. Without it, that's not an option, according to Battiston. 'You can't send people to Mars just to have them die of cancer when they return to Earth,' he says.

SR2S is thus helping to ensure that we will eventually be able to boldly go where no Earthling has ventured before. 'Tackling such a difficult problem is fascinating,' Battiston concludes. 'It calls for new ideas and new approaches to push the technologies to the extreme. This kind of challenge is an extraordinary technology driver, which first and foremost benefits applications on Earth.'

SR2S

- ★ Coordinated by the National Institute for Nuclear Physics in Italy.
- ★ Funded under FP7-SPACE.
- ★ http://cordis.europa.eu/project/rcn/106623_en.html
- ★ Project website: http://www.sr2s.eu/
- ★ http://bit.ly/1ALkdz6

ZERO DOWNTIME FOR GNSS APPLICATIONS

A new software developed by EU-funded researchers promises to reduce the impact of ionospheric disturbance on GNSS operations.


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'Global navigation satellite systems' (GNSS) may be an integral part of our daily lives — to the point where we rely on them for most travel journeys in unfamiliar places — but they are still far from infallible. One phenomenon known as ionospheric disturbance, where solar flares cause a sudden increase in radio-wave absorption that often delays the propagation of signals and ultimately affects positioning, has been keeping researchers busy for years.

The CALIBRA (Countering GNSS high Accuracy applications LImitations due to ionospheric disturbances in BRAzil) project team has been participating in this global research effort with a particular focus on Brazil, which is one of the most exposed regions due to its proximity to the magnetic equator. Added to this, the sun is at its peak of activity, since it entered its new 11-year cycle in 2010.

After 27 months of intensive research, the CALIBRA team have just come up with exciting new solutions to counter the ionospheric disturbance problem. They recently showcased a commercially applicable approach to mitigate the phenomenon's impact on high accuracy GNSS positioning techniques, thanks to two real-life demonstrations where their newly developed algorithm was tested in actual precision agriculture and offshore operations.

Enormous potential

The project consisted of three major steps. First, the team confirmed that ionospheric scintillation and variations in 'Total electron content' (TEC) had a direct impact on the functioning of GNSS 'Precise point positioning' (PPP) and 'Real time kinematic' (RTK) positioning — techniques that provide centimetre level accuracy thanks to the use of reference stations — after which they characterised the disturbances with a suitable metric.

The project then produced a short-term empirical model for forecasting TEC and scintillation. The latter was tested using the CIGALA-CALIBRA network and database — a network of ionospheric scintillation monitor receivers with a web interface (the ISMR Query tool) which collects over 10 million observations on GPS, Glonass, Galileo, Beidou and other global navigation systems every day. Since it was launched in December 2014, this data has helped assist users from over 20 countries thanks to the software's visualisation and mining techniques.

In light of this success, CALIBRA partners filed a patent for their forecasting model, and a new spin-off company, SpacEarth Technology, was set up. SpacEarth's main purpose is to secure the software's commercialisation in relevant applications and services, while also improving and adapting it to evolving market needs.

One of the first realisations of the new company is a firmware update for project partner Septentrio's GNSS receivers. The latter also built on the project's outcomes to create a next generation RTK engine including a new model for estimating ionospheric delay, which has already proven valuable for very long baseline RTK and for mitigating ionospheric effects.

In addition to this competitive edge, the project's results promise to considerably reduce downtime and financial losses caused by ionospheric disturbance in Brazil and other regions of the world.

CALIBRA

- Coordinated by the University of Nottingham in the United Kingdom.
- Funded under FP7-GALILEO.
- http://cordis.europa.eu/news/rcn/122798_en.html
- Project website: http://www.calibra-ionosphere.net/

A COMMON LANGUAGE TO BOOST FUTURE SPACE EXPEDITIONS

EU-funded researchers with the IMPEX project have made it possible to compare data from numerous space missions, potentially increasing our knowledge of the solar system.

When astronauts first gazed down at our planet, humankind received a visceral reminder that we all come from one place. EU-backed scientists are confident that another giant leap forward in space exploration has just been taken with the establishment of a common data hub.

This hub, developed through the four-year IMPEX (Integrated medium for planetary exploration) project with nearly EUR 2 million in EU funding through FP7, addresses a key problem that has consistently hampered cooperation in space exploration; the fact that complex computational models used on various space expeditions have not been compatible. This means that the exchange and comparison of observational data between missions has not always been possible.

Thanks to IMPEX, scientists will now be able to compare observational data with simulation models, and essentially 'speak the same language' as scientists across the globe. The project has developed a portal that enables a huge amount of information received from past and ongoing missions to be available at one single point, along with tools to make this information accessible.

The four-year project has already been put into use. Scientists have been able to compare data taken from the European Space Agency (ESA)'s Venus Express mission launched in 2005 and NASA's Messenger mission, which

orbited Mercury between 2011 and 2015, with existing simulation models. Comparisons with observational data from the ESA's famous Rosetta mission, which made the first soft landing on a comet in 2015, are expected to follow in the near future.

"The project has developed a portal that enables a huge amount of information received from past and ongoing missions to be available at one single point."

By comparing observational data with a simulation of the cometary environment, scientists hope to gain a much clearer understanding of how our solar system came into existence. Research into the magnetic fields surrounding Venus, Mercury and other objects in the solar system has also been advanced.

In order to get to this point however, the project first had to bring together experts from Austria, France, Finland and Russia to specify key requirements and outline possible obstacles. This enabled the team to design the functional and easy-to-use software and to define common data models. The project was then able to develop a single point of access to an impressive range of tools that can be used to work with different data in the field of plasma physics.

Within the IMPEX portal, the CDPP 'Automated multi-dataset analysis' (AMDA) tool provides simple access and easy-to-use data mining functionalities. Another tool is the CDPP 3DView, which enables scientists to simulate spacecraft trajectories. In fact, all IMPEX databases directly feed into 3DView, enabling an interactive combination of spacecraft orbits with *in situ* measurements and simulation data.

Completed at the end of May 2015, IMPEX is expected to boost understanding and cooperation between modelling and space mission data experts, and help lay the groundwork for future missions in a cost-effective and highly collaborative manner.

IMPEX

- Coordinated by the Austrian Academy of Sciences in Austria.
- Funded under FP7-SPACE.
- http://cordis.europa.eu/news/rcn/122926_en.html
- Project website: http://impex-fp7.oeaw.ac.at/

FROM GALILEO TO MULTI-SYSTEM POSITIONING

Evolution of the 'Global navigation satellite system' (GNSS) into a system of systems opens up a new world of satellite-based applications. EU-funded scientists have developed a multi-satellite receiver that will improve the integrity, precision and accuracy of positioning.

The European Galileo has already established ramp-up plans, the United States' 'Global positioning system' (GPS) is under modernisation, and the Russian 'Global navigation satellite system' (GLONASS) is being restored. In addition, there are the 'European geostationary navigation overlay service' (EGNOS) and the 'Wide area augmentation system' (WAAS).

Together, they lay out challenges for designing positioning receivers that have to cope with multiple frequencies, message protocols and system parameters. In this context of demanding technological innovations, the E-HIMALAYA (Extended-high performance mass market GNSS receiver multi standard ready for market) project was initiated.

An initial research and development phase allowed for exploring different directions for improving GNSS receiver performance. The receiver is assisted by a communications link to speed up the acquisition and find weak Galileo signals in dense urban areas or indoors. Special emphasis was placed on delivering data from at least two constellations, Galileo and GPS.

The E-HIMALAYA partners' assisted-GNSS server was upgraded to support the 'Secure user plane location' (SUPL) v2.0 protocol. This is the emerging standard for exchanging information between positioning servers and mobile devices. Its numerous capabilities make it ideal for the next generation of location-enabled services.

Extensive testing proved that one of the first assisted-Galileo solutions to be developed based on 3rd Generation Partnership Project (3GPP) assistance standards allows for reducing the time needed to calculate the user's position, the so-called time-to-first-fix. The test results will be shared with 3GPP to contribute to future improvements in its standards.

Next, E-HIMALAYA focused on hybridisation of the assisted-GNSS receiver with other technologies. The ready-to-market prototype includes high-performance microelectromechanical system sensors, including an accelerometer and gyroscopes. In addition, a spoofing detector allows for further enhancing the precision and accuracy of positioning.

The performance of hybridisation and spoofing detection algorithms will be assessed using real signals in harsh environments, such as urban canyons. The assisted-GNSS receiver could be integrated into platforms for mobile and personal devices. Its application will demonstrate the added value of Galileo in real mass-market environments.

E-HIMALAYA

- Coordinated by Thales Alenia Space in France.
- Funded under FP7-TRANSPORT.
- http://cordis.europa.eu/result/rcn/159795_en.html
- Project website: http://www.fp7-e-himalaya.com


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EVENTS

AUGUST
02▶06

Montpellier, FRANCE

CONGRESS

27TH INTERNATIONAL CONGRESS FOR CONSERVATION BIOLOGY (ICCB) AND 4TH EUROPEAN CONGRESS FOR CONSERVATION BIOLOGY (ECCB) — ICCB-ECCB 2015

ICCB-ECCB 2015 will take place from 2 to 6 August in Montpellier, France.

The Society for Conservation Biology (SCB) is proud to team up for the first time with Agropolis International and the French Foundation for Research on Biodiversity (FRB) to host the 27th International Congress for Conservation Biology (ICCB) and the 4th European Congress for Conservation Biology (ECCB). The joint meeting brings together the international community of conservation professionals to address conservation challenges and present new findings, initiatives, methods, tools and opportunities in conservation science and practice. Authors from 109 countries have submitted abstracts to present their research at ICCB-ECCB 2015.

For further information, please visit:
http://iccb-eccb2015.org/

AUGUST
05▶06

Paris, FRANCE

CONFERENCE

3RD JOURNAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND DEVELOPMENT (JCESD 2015 3RD)

The 3rd Journal Conference on Environmental Science and Development (JCESD 2015 3rd) will take place from 5 to 6 August in Paris, France.

The aim of the conference is to provide a forum for researchers, practitioners and professionals from industry, academia and government to discuss research and development and professional practice in environmental science and development. All paper submissions will be peer reviewed and evaluated based on originality, technical and/or research content/depth, correctness, relevance to conference, contributions and readability. Submissions will be chosen based on technical merit, interest, applicability and how well they fit in with a coherent and balanced technical programme.

For further information, please visit:
http://www.ijesd.org/jcesd/3rd/index.htm

AUGUST
25▶28

Vienna, AUSTRIA

CONFERENCE

INTERNATIONAL CONFERENCE ON SCIENCE, ECOLOGY AND TECHNOLOGY 1 (ICONSETE 2015)

The International Conference on Science, Ecology and Technology 1 (ICONSETE 2015) will take place from 25 to 28 August in Vienna, Austria.

ICONSETE 2015 aims to be one of the leading international conferences for presenting novel and fundamental advances in the fields of science, ecology and technology. It also seeks to foster communication among researchers and practitioners working in a wide variety of scientific areas with a common interest in improving technology, science, social sciences, medical and engineering-related disciplines. ICONSETE 2015 is sponsored by eight universities, two international organisations and state institutions.

For further information, please visit:
http://www.iconsete.org/


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AUG./SEPT.
31▶03

Athens, GREECE

CONFERENCE

4TH INTERNATIONAL EURASIAN CONFERENCE ON MATHEMATICAL SCIENCES AND APPLICATIONS (IECMSA-2015)

The 4th International Eurasian Conference on Mathematical Sciences and Applications (IECMSA-2015) will take place from 31 August to 3 September 2015 in Athens, Greece.

The main aim of this conference is to contribute to the development of mathematical sciences and its applications and to bring together the members of the mathematics community, interdisciplinary researchers, educators, mathematicians, statisticians and engineers from all over the world.

The conference will present new results and future challenges, in series of invited and short talks and poster presentations.

For further information, please visit:
http://www.iecmsa.org/

EVENTS

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

SEPTEMBER 02▸04

Oxford, UNITED KINGDOM

FORUM

4TH INTERNATIONAL SCIENTIFIC FORUM (ISF 2015)

The 4th International Scientific Forum (ISF 2015) will take place from 2 to 4 September 2015 in Oxford, United Kingdom.

The theme of the forum will be 'Education, Climate Change and Economic Development'. ISF 2015 will bring together researchers, policy makers and company employees from all around the globe to discuss these major societal challenges. Supporting the concept of multidisciplinarity, interdisciplinarity and transdisciplinarity, the meeting will welcome papers in different academic disciplines. Submissions in the following areas are especially welcome: health care, medicine, climate studies, peace studies, environment, biology, law, management, economics, social work, sociology, psychology, history, geography, education, politics, engineering, physics, mathematics, chemistry and gender studies.

For further information, please visit:
http://isfoxford.com/

SEPTEMBER 02▸04

Bristol, UNITED KINGDOM

MEETING

23RD ANNUAL MEETING OF THE EUROPEAN ORTHOPAEDIC RESEARCH SOCIETY (EORS 2015)

The 23rd Annual Meeting of the European Orthopaedic Research Society (EORS 2015) will take place from 2 to 4 September in Bristol, United Kingdom.

The meeting will cover the full range of orthopaedic research from bench-top to bedside including cellular therapy, mechanisms of disease, novel implants, biomechanics, clinical trials, epidemiology and registries. The aim is to bring together a broad spectrum of researchers and clinicians to share their latest research findings and plan future collaborations. In particular, the organisers welcome young investigators who wish to draw on the experience and expertise of senior mentors from across Europe.

For further information, please visit:
http://eors2015.org/index.html

SEPTEMBER 10▸12

Athens, GREECE

CONGRESS

INTERNATIONAL SOCIETY FOR VASCULAR SURGERY 2015 CONGRESS

The International Society for Vascular Surgery 2015 Congress will take place from 10 to 12 September in Athens, Greece.

The International Society for Vascular Surgery (ISVS) invites practising vascular surgeons, vascular specialists and other related health professionals interested in further expanding their knowledge in the field of vascular and endovascular surgery to attend the congress. The scientific programme will feature world-renowned leaders who will cover everything relevant in the arterial and venous areas and address the latest scientific and technological advances related to vascular and endovascular surgery. Industry representatives will have booths available for presenting their technologies, products and services.

For further information, please visit:
http://www.erasmus.gr/microsites/1039

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SEPT. 21▸23

Lyon, FRANCE

SYMPOSIUM

2ND INTERNATIONAL SYMPOSIUM OF THE CANCER RESEARCH CENTER OF LYON

The 2nd International Symposium of the Cancer Research Center of Lyon will take place from 21 to 23 September in Lyon, France.

The symposium aims to gather together scientists and clinicians interested in cancer biology and its therapeutic innovations, and to present the latest scientific advances in these fields. It will address crucial questions about the fundamental issues of cancer biology with a special emphasis on interactions between basic, clinical and translational research. The theme will be 'The Tumor and its Microenvironment: Challenges and Innovative Therapies'.

For further information, please visit:
http://www.crclsymposium2015.fr/index.php?langue=en&onglet=3&acces=&idUser=&emailUser

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THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

HORIZON 2020

PROJECT INFORMATION NOW AVAILABLE ON CORDIS

Almost 4000 project factsheets from Horizon 2020 – the first wave of the EU's biggest ever research and innovation framework programme – can now be browsed and searched on CORDIS.

CORDIS is continuing its role as the European Commission's primary public repository, containing over 100000 EU-funded research projects and results stretching back 25 years and now extending its services to Horizon 2020 projects.

The first Horizon 2020 grants were signed in 2014 and hundreds of new projects are being added every month. CORDIS retrieves its information from the grant agreements, publishing for each project its acronym, costs, topic, funding scheme, objectives, coordinating and participating organisations, including the EC contributions for each beneficiary. Horizon 2020 projects can currently be found through their programme area and topic but further information is planned to be added like project websites, contact persons and cross-cutting domains. A more thematic approach to information will also be explored.

H2020 projects' publishable reports will also be made available on CORDIS in the future, alongside the thousands of Report Summaries currently being provided by FP7 projects. The publication of these reports will later be followed with multilingual Results in Brief for each project and coverage in the free *research*eu results magazine* — making it easier to identify exploitable results and opportunities for innovation.

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