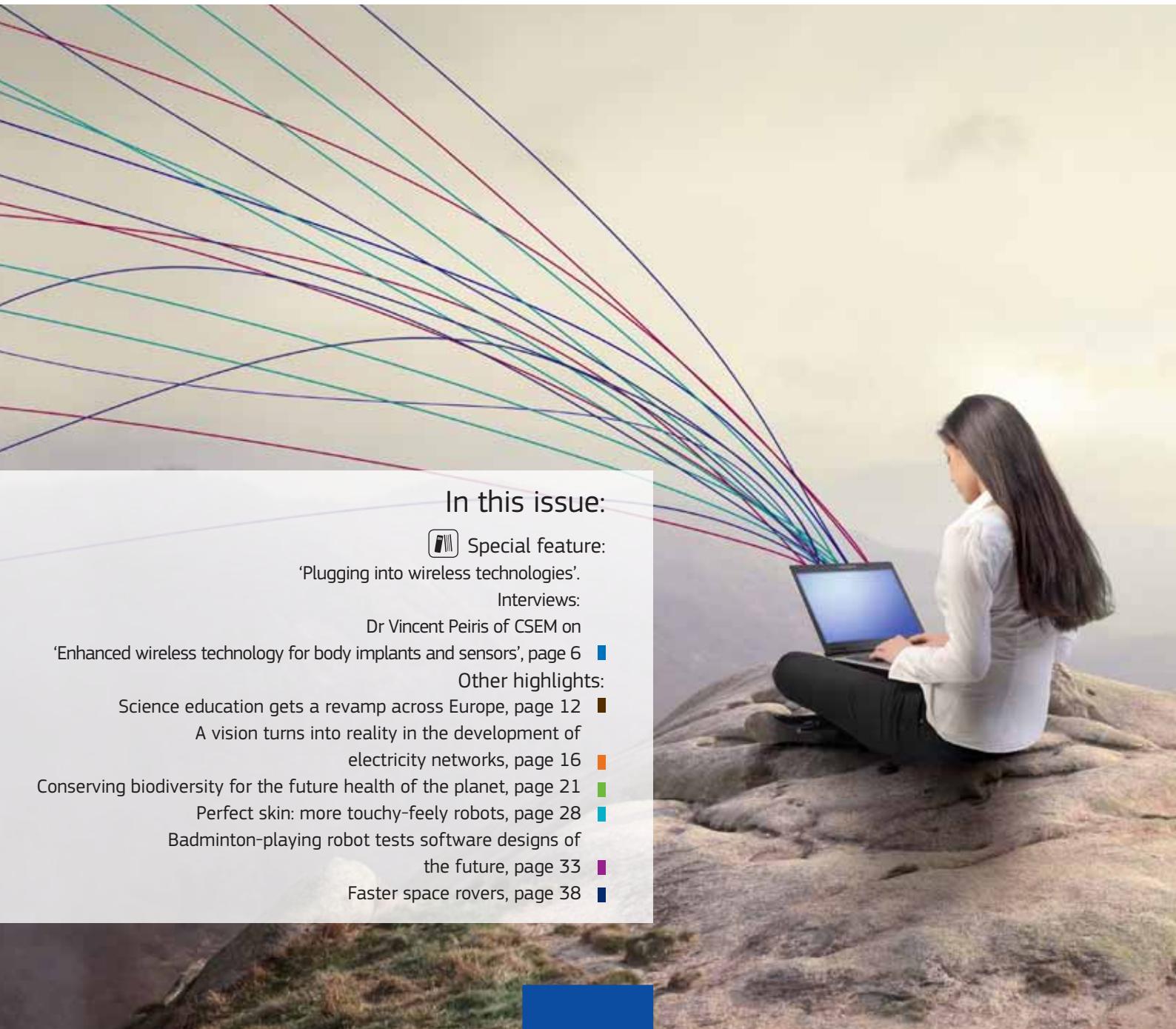




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RESULTS MAGAZINE

No 24 July/August 2013



In this issue:

Special feature:

'Plugging into wireless technologies'.

Interviews:

Dr Vincent Peiris of CSEM on

'Enhanced wireless technology for body implants and sensors', page 6 ■

Other highlights:

Science education gets a revamp across Europe, page 12 ■

A vision turns into reality in the development of
electricity networks, page 16 ■

Conserving biodiversity for the future health of the planet, page 21 ■

Perfect skin: more touchy-feely robots, page 28 ■

Badminton-playing robot tests software designs of
the future, page 33 ■

Faster space rovers, page 38 ■

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EDITORIAL

Connecting people, better and faster

The concept of ‘connection’ — influenced by the advent of mobile phones and social networks — has changed drastically over the last 30 years. Wires are progressively making way for radio waves. Technologies like the internet, smart phones and Bluetooth have become ubiquitous. It therefore comes as no surprise that becoming a leader in this booming sector would provide the European economy with a major boost.

With initiatives such as the ‘Roadmap to a wireless Europe’ which aims to provide 30 Mbps broadband access to all EU citizens, recent investments in the development of a future 5G network, and the recent promise of a single mobile market by 2015, the European Commission is actively carving out the way towards faster innovation in the sector. And to better see what the future holds, this issue of *research*eu results magazine* is focusing on ‘Plugging into wireless technologies’.

We interview Dr Vincent Peiris, project coordinator of the WISERBAN project, who starts the ‘biology and medicine’ section by explaining how the project will eventually allow for the development of smaller, less-energy-consuming and always-connected body implants. Other articles linked to this month’s special focus can be found in the ‘environment’, ‘IT and telecommunications’, ‘industrial technologies’ and ‘space’ sections.

After the ‘social sciences and humanities’ section, which starts with ‘Science education gets a revamp across Europe’ on page 12, the ‘energy and transport’ section opens on page 16 with ‘A vision turns into reality in the development of electricity networks’.

The ‘environment’ section begins with ‘Conserving biodiversity for the future health of the planet’ on page 21, followed by the ‘IT and telecommunications’ section and a captivating story entitled ‘Perfect skin: more touchy-feely robots’, on page 28. The ‘industrial technologies’ section then opens with ‘Badminton-playing robot tests software designs of the future’ on page 33, while the ‘space’ section features the story ‘Faster space rovers’ on page 38.

The issue ends, as usual, with a list of events and upcoming conferences.

We look forward to receiving your feedback on this issue and on the *research*eu* publications in general. Send questions or suggestions to: cordis-helpdesk@publications.europa.eu

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Special topic

Each issue of the *research*eu results magazine* sheds light on a specific science topic. To find out more about the latest results and findings, look out for this icon next to article headlines.



Videos

Want to see EU research projects in motion? Some of the projects presented in this issue have a dedicated video available on the internet. To view a video, just open the digital version of the magazine (available at <http://cordis.europa.eu/research-eu>) and click on this icon.

See you next month!

Coming up in issue 25 of *research*eu results magazine* — a special dossier called ‘The big clean-up: how to tackle toxic substances’.



TABLE OF CONTENTS

BIOLOGY AND MEDICINE	6
Enhanced wireless technology for body implants and sensors	6
Throwing more light on skin cancer.....	8
Paving the way for thought-controlled prostheses	8
A boost for safety in rescue situations.....	9
New treatment may lead the way to fighting obesity and diabetes	10
Engineering plants to produce vaccines.....	10
Bioelectronic devices for biomedical applications.....	11
SOCIAL SCIENCES AND HUMANITIES	12
Science education gets a revamp across Europe	12
United in diversity: how to live with difference in Europe?	13
Help for young people in a changing world.....	14
How ageing impacts economic growth.....	14
Climate change and cultural heritage.....	15
ENERGY AND TRANSPORT	16
A vision turns into reality in the development of electricity networks	16
Crops for energy	17
New car engine is cheaper and greener.....	17
Improving design of offshore wind turbines.....	18
Cheap fuel from sugar cane.....	18
Storing hydrogen in solid form for mobile application	19
Greener car technology reduces emissions.....	20
Accelerating the pace of particle physics research	20
ENVIRONMENT AND SOCIETY	21
Conserving biodiversity for the future health of the planet.....	21
Better detection methods for vine disease	22
Cleaning up Europe's former industrial zones	23
Self-powered wireless sensors and network for smarter, greener buildings.....	23
Major pan-European study conducted on ocean acidification.....	24
Understanding the environment's role in birth defects	25
Developing a clearer understanding of ocean ecosystems	26
GEO technology initiative goes to central Asia	26
Plankton as a climate-change sensor	27



TABLE OF CONTENTS

IT AND TELECOMMUNICATIONS

Perfect skin: more touchy-feely robots.....	28
Transnational access to supercomputing.....	29
Video surveillance leaps into the future	30
Internet-TV combination makes life easier	30
All-optical broadband ... cheaper, faster and greener	31
Tactile blisters and internet access for the visually impaired	32
High-tech communications to the rescue	32



INDUSTRIAL TECHNOLOGIES

Badminton-playing robot tests software designs of the future.....	33
Railway learning reaches higher ground	34
Sensitive bomb detector to rove in search of danger.....	34
Super surfaces at your service.....	35
Unbreakable materials on the horizon.....	36
Fast, effective manufacturing of small, complex parts.....	37



SPACE

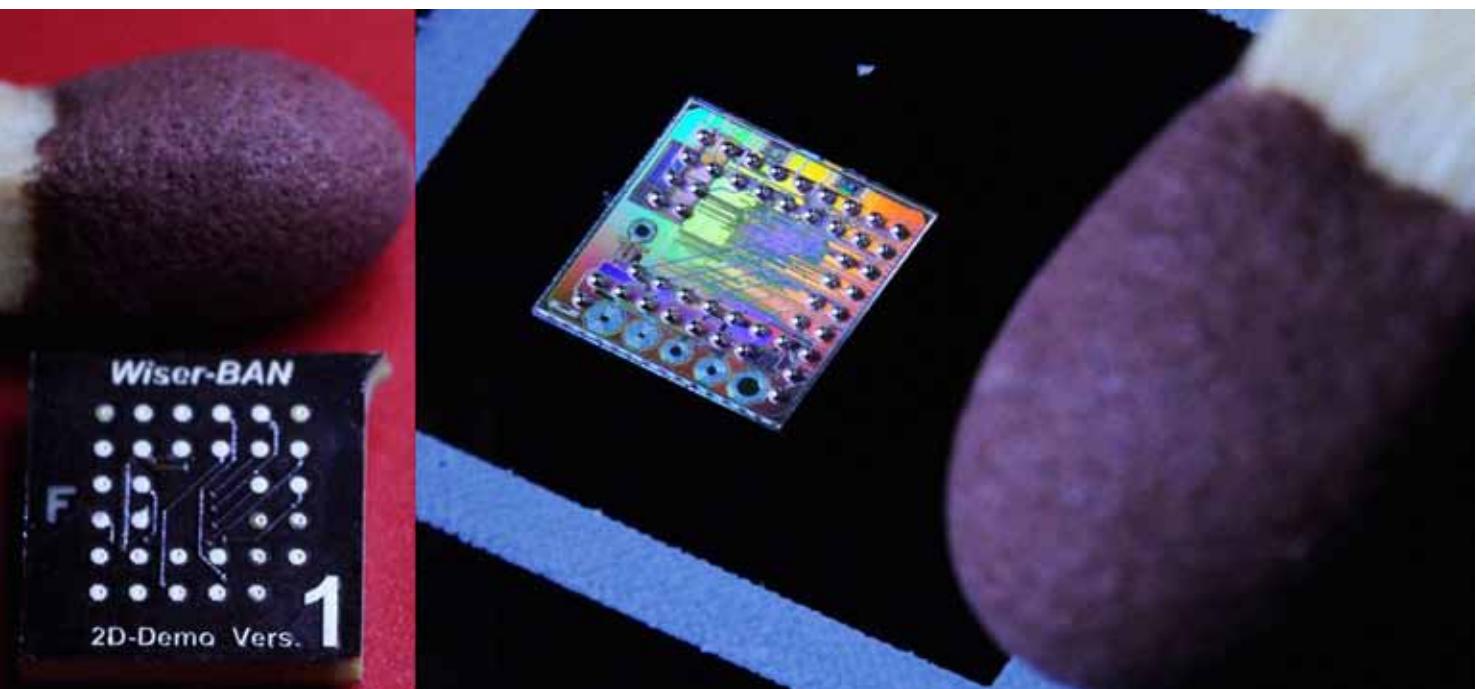
Faster space rovers.....	38
Processing and compressing space data.....	39
Pushing ahead with new forms of propulsion in space.....	39
High-tech garbage removal to clear the space raceway.....	40
Monitoring the Arctic from above.....	41
Massive new insight into the ionosphere	41



EVENTS

42

BIOLOGY AND MEDICINE



© WiserBAN

Enhanced wireless technology for body implants and sensors

Body implants such as pacemakers and hearing aids have been used to counter organ dysfunction for decades. The WISERBAN¹ project is making a giant leap in their development: aiming to provide smarter communications among such devices, with reduced size and lower energy consumption.

In the near future, people affected by health issues as varied as Alzheimer, diabetes, hearing loss, heart failure or even missing limbs could all have something in common: a smart, efficient, in-body or on-body device that makes their daily life easier and more enjoyable. To this end, the development of tiny and ultra-low-power wireless communications is key. It allows these devices to communicate changes in conditions and adjust treatments accordingly.

Only limited autonomy and wireless connectivity can be achieved using today's wireless solutions because of their size and power consumption. Conscious of the fact that this limitation is currently holding back 'wireless body-area network' (WBAN) capability for use in lifestyle and bio-medical applications, the WISERBAN project brings together major medical-device manufacturers, research institutes and chip makers to overcome this obstacle.

WISERBAN is focusing on the extreme miniaturisation of 'body-area network' (BAN) devices. It touches on the areas of radio-frequency (RF) communications, 'Microelectromechanical systems' (MEMS) and miniature components, miniature reconfigurable antennas, miniaturised and cost-effective system-in-package (SiP), ultra-low-power MEMS-based radio system-on-chip (SoC),

sensor signal processing and flexible communication protocols.

During an interview with *research*eu results magazine*, the project coordinator, Dr Vincent Peiris tells us more about the project's contribution to improving state-of-the-art technology, and how its outcomes will enhance comfort and access to ICT for impaired and disabled people of all ages. Dr Peiris is Section Head for RF and Analog IC Design at the Centre Suisse d'Electronique et de Microtechnique (CSEM) in Neuchâtel, Switzerland.

What are the main objectives of the project?

There is a growing resort to next-generation wireless body-area networks for smarter medical, health-care and lifestyle devices. Networking sensors worn on the body or implanted in the body are being developed, and a key enabler of such technology resides in tiny and ultra-low-power wireless communications. In this context, WISERBAN aims to develop an ultra-miniature wireless microsystem comprising a 2.4GHz radio, a microprocessor for the sensor data processing, and RF MEMS devices for improved radio performance, all combined in a 4 x 4 x 1 mm³ system-in-package with power consumption of around a few milliwatts. The target is to achieve

devices that are 50 times smaller, and with power demands that are 20 times lower than existing consumer products, which generally rely on classical solutions like Bluetooth.

What is new or innovative about the project and the way it is addressing these issues?

The WISERBAN consortium is unique as it is federated around four leading industrial partners — SORIN for cardiac implants, Siemens Audiology Solutions for hearing aids, Debiotech for insulin pumps, and MED-EL for cochlear implants — which together bring in stringent and market-oriented requirements. Their products are fairly different because some are implanted while others are worn on the body. Also, targeting health care comes with constraints that are not necessarily the same as for lifestyle demands. Nonetheless, it was possible to define commonalities with respect to the wireless communication layer, which allowed us to engineer a dedicated radio specification and architectural breakdown for driving the current technology developments.

The two major innovations brought by the WISERBAN device are its unique low-power radio architecture and its size: 4 x 4 x 1 mm³. At the radio level, we created a unique combination of

BIOLOGY AND MEDICINE

ultra-deep-submicron ‘complementary metal-oxide-semiconductor’ (CMOS) circuits with a heterogeneous set of MEMS devices — such as ‘bulk acoustic wave’ (BAW) RF resonators, ‘surface acoustic wave’ (SAW) RF filters and low-frequency ‘silicon resonators’ (SiRes) — whereas today’s approach relies on CMOS-only chips which require several external and bulky passive components such as crystals and RF filters.

The joint usage of MEMS with CMOS enables much smaller SiP integration when compared to modules using CMOS chips, as well as the engineering of disruptive radio architectures which use the advantages of MEMS devices to compensate for limitations in the CMOS circuits — and vice versa. This allows for a highly efficient start-up time for the transceiver section, thereby enabling rapid wake-up of the radio. This is crucial for low-power operation as it eliminates the unnecessary current consumption that normally arises from the slow start-up of classical radio architectures.

In parallel, we developed a miniaturised SiP approach for achieving the $4 \times 4 \times 1 \text{ mm}^3$ target while being affordable from a commercial point of view. Current solutions, like three-dimensional (3D) silicon integration, suffer from technical complexity and are rather costly for silicon foundries to implement in their flows. With WISERBAN, the CMOS and MEMS devices are embedded within very tiny epoxy laminates, and these flat two-dimensional (2D) SiPs can then be stacked together by solder-bumping to realise tiny 3D SiPs. The cost-effectiveness and inherent modularity of this SiP platform allows it to be easily configured to address the variety of end-user requirements.

What are some of the difficulties you have encountered and how did you solve them?

WISERBAN is about pushing innovation into many wireless technologies, such as miniature antennas, radio chips, digital-processing circuits and MEMS devices, but also software for system control and for wireless sensor networking. System integration — which is about getting them to work together in a unique demonstrator or a product — is thus a very complex task and a major project challenge. It has required the development of rigorous top-down specification and architecture breakdown, making sure that each block takes into account its environment conditions and interfaces with other components. Research teams across several EU countries naturally tend to concentrate on the scientific challenges of their own blocks taken individually, so system integration has also been about ensuring efficient and regular interactions between them. Creating an enabling and stimulating environment for proper system integration and playing the role of system integrator has been a major task for CSEM as scientific coordinator of the project.

A concrete example is the successful realisation — at the first attempt — of the WISERBAN SoC,

which is the system integration of several technology ‘bricks’ like MEMS and radio circuits with a ‘digital signal processor’ (DSP) on a single silicon die in 65 nm CMOS. On the other hand, other technology bricks, such as the SiRes MEMS, have proved very challenging to achieve because an entirely novel fabrication, processing and encapsulation flow has to be invented, and this has proved to be lengthier than expected in order to deliver devices giving satisfactory performance. To solve such issues, synergistic interaction with another EU-funded FP7 project — GO4TIME² which deals with similar MEMS issues — was established to deliver contingency technology items for the WISERBAN SiRes MEMS.

What are the concrete results from the research so far?

These include the first version of WISERBAN SoC, which integrates on a single chip in 65 nm CMOS a complete MEMS-based transmitter and a digital signal processor of the icyflex family, and was functional at the first attempt. Currently the teams are working to integrate the remaining blocks for the final version of the SoC.

Another very interesting result is the availability of the first miniature antenna prototypes which have been developed taking into consideration the stringent environment and propagation conditions related to end-user housings (e.g. hearing-aid housing, cochlear implant housing). Both passive and active antennas — active meaning that the device incorporates tuning mechanisms to cover the entire 2.4 GHz frequency band — have been developed and characterised successfully at laboratory level. The next step is to combine them with the WISERBAN SoC and verify proper functionality when implemented in the selected housings.

At MEMS level, several first prototypes were developed and demonstrated successfully, such as the BAW resonators and filters, and the SAW filters. First promising results for the SiRes MEMS have been shown on wafer-in-air, but need to be confirmed under vacuum packaging. The next step is to stabilise the SiRes packaging process, which is a critical challenge currently being addressed.

On the software side, the industrial end-user partners have elaborated a common framework for building the control software pieces. On the wireless networking side, a dedicated protocol stack was developed and optimised with respect to low-power communication for body-sensor networks. The potential of this protocol has already been demonstrated on a benchmark sensor network constructed with off-the-shelf radio circuits, in anticipation of implementing a WISERBAN network.

When do you expect the technology to start benefiting European citizens?

The technology should benefit EU citizens once the complete WISERBAN technology is installed



© Vincent Peiris

Dr Vincent Peiris of CSEM

in end-user products. This is expected around 2015 — maybe later for those products which are related to health care and hence require more certification steps. Specific technology bricks, like some circuits or MEMS devices, could be leveraged towards semiconductor products earlier, in 2014.

What are the next steps of the project, or next topics for your research?

Beyond the WISERBAN project, several topics have emerged for future research. WISERBAN is currently concerned with applications operated with tiny batteries — so a first research path would be to push system integration further by combining it with emerging energy-harvesting technologies that could collect energy from moving limbs, heartbeats, or body heat.

Another interesting path is the further reduction of the volume and size of wireless microsystems, by exploring disruptive radio architectures using next-generation CMOS technologies (e.g. down to 10 nm CMOS) or beyond-CMOS technologies (based on nanomaterials). Such approaches pave the way towards zero-energy and virtually invisible communication devices, and will enable a plurality of novel health-care and bio-medical applications, such as smart skin for human prosthetics, unobtrusive monitoring devices for healthy living and ageing, networks of implants for assisting surgical interventions, or tiny implanted neuro-stimulation solutions for curing neurological disorders.

The project was coordinated by the Centre Suisse d’Electronique et de Microtechnique (CSEM) in Switzerland.

- 1 ‘Smart miniature low-power wireless microsystem for body-area networks’.
- 2 ‘Global, flexible, on-demand and resourceful timing IC & MEMS encapsulated system’.

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Information and communication technologies’ (ICT). Project website: <http://www.wiserban.eu/>

BIOLOGY AND MEDICINE



Throwing more light on skin cancer

EU researchers have developed a new imaging platform for the early diagnosis of skin diseases. Skin cancers are one of the most common types of the disease in Europe.

The number of skin cancer sufferers in Australia, Europe and the United States is rising at an alarming rate. It is estimated that one in five people will develop some form of skin cancer during their lifetime. The vast majority of these will have been caused by overexposure to the ultraviolet (UV) rays of sunlight.

UV radiation penetrates the skin and causes cell damage that, over time, can potentially develop into skin cancer. There is an urgent need to significantly improve current diagnostic tools, both for the early identification of skin disorders and for monitoring their treatment.



With this goal in mind, the SKINSPECTION¹ project was established. Spread over three phases, the project set out to develop a non-invasive and multimodal hybrid imaging system which would produce high-resolution, three-dimensional (3D) images of very small areas of skin.

Initially, all technological aspects of the project were evaluated and a development plan was drawn up. In the second project phase, new imaging methods were developed using light and sound waves to examine live cells and tissue. All these methods were integrated into the new multimodal system for early diagnosis of skin diseases and, finally, the new platform was clinically validated.

The success of the SKINSPECTION project provides a unique tool not only for early diagnosis and treatment control of skin cancer, but also for other skin-related conditions. In addition, it will significantly contribute to the improvement of the European health-care system.

The project was coordinated by the Fraunhofer Institute for Material and Beam Technology (IWS) in Germany.

1 'Multimodal skin inspection with hybrid acoustic & optical spectroscopic imaging'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.
<http://cordis.europa.eu/marketplace> > search > offers > 10552
 Project website:
<http://www.skinspection-fp7.eu/>

Paving the way for thought-controlled prostheses

Understanding how the brain processes new skills and actions could help improve learning and aid research into neurodegenerative and psychiatric disorders such as Parkinson's and Huntington's disease. An EU-funded project has collected new data on the development of the neural mechanisms relating to action learning, habit formation and addiction through the manipulation of the brain's molecular networks. This could lead to breakthroughs in thought-controlled prostheses.

Some actions undertaken by living things are innate or pre-wired, such as swallowing, breathing and even grooming. Others are learned throughout life through trial and error. The EU-funded NEUROACTION¹ project studied the neurological changes (changes in the brain, spinal cord and nervous system) which take place when actions are learned through the reaction to stimuli, facts and events.

The project's findings give hope to sufferers of neurodegenerative conditions such as Parkinson's and Huntington's disease and could provide those who have suffered spinal-cord injuries, amputations and other disabilities the possibility of regaining mobility through

the use of thought-controlled prostheses.

'The results from this research will help us understand how we automatise skills and form habits, and how we make decisions in everyday life,' explains Dr Rui Costa, a researcher in the NEUROACTION project. 'They will also hopefully help us understand addictions — as many addictive drugs impinge on these circuits — and compulsions.'

The learning of new skills takes place in a specific part of the brain known as the *striatum*. However, the detailed mechanisms and circuits underlying the role of the *striatum* in the acquisition and consolidation of skills are not fully

understood. The aim of the project is to build a clearer picture of how the molecular networks in this area of the brain adapt. Results showed that the synapses in the connecting area between the *striatum* and the cerebral cortex (the area of the brain responsible for higher functions of the nervous system) exhibit long-term 'plasticity' during skill-learning, a necessary adaptation in developing and retaining newly acquired skills.

'We wanted to investigate if the neural circuits responsible for our automated responses or habits were different to the neural circuits mediating our goal-directed or intentional actions,' says Dr Costa. 'In particular, we wanted to know

if different striatal circuits were mediating newly acquired versus automated actions.'

The team found that circuits coursing through the *dorsomedial striatum* — the area of the *striatum* concerned with action selection and evaluation, as well as value-based decision-making — are more important for novel actions. In addition, circuits in the *dorsolateral striatum* — a different area of the *striatum* which deals with performance and habitual enactment of skills — are critical for automated skills, such as driving your car home or riding a bike.

The project team also believes that the *dorsolateral striatum* has the potential to be trained, which could lead to the control of implanted prosthetic devices. Their findings might open the door to the development of thought-controlled prostheses restoring normal mobility levels for people with spinal-cord

BIOLOGY AND MEDICINE



© MINDWALKER

injuries, amputations and other disabilities.

In addition, NEUROACTION investigated the possible links between dysfunction in the *striatum* and cerebral cortex, and neurodegenerative conditions such as Parkinson's and Huntington's disease. 'The links we've found are that cells that die in Huntington's and Parkinson's disease are abundant in the areas necessary for automatisation and habit formation,' explains Dr Costa.

Using specialised equipment and resources, the team carried out tests into neural activity in region-specific areas of the *striatum* during the different phases of skill-learning in genetically modified mice.

Learning from the animals

The modified mouse genetics allowed the team to target specific circuits, while the use of optogenetics — a combination of optics and genetics to control the activity

of individual neurons, nerve cells which transmit information in living tissue — enabled the researchers to manipulate such circuits with great precision. The activity of those brain circuits was then monitored using electrophysiology — the study of the electrical properties of biological cells and tissues.

The initial findings from these tests provided important data on the processes of skill learning and execution, and on the development of impairments observed in neurodegenerative and psychiatric disorders.

NEUROACTION's work is financed to the tune of EUR 100 000 by the Marie-Curie Actions, an EU research fund managed by the Research Executive Agency (REA). Dr Rui Costa has also received a Starting Grant from the European Research Council (ERC) of around EUR 1.5 million for the project NEUROHABIT to pursue his research.

NEUROACTION's research into the link between neural circuits and behaviour will continue under the Human Brain Project (HBP) which has been announced as one the EU's Future and Emerging Technologies (FET) Flagship Projects. HBP will run from 2013 until 2023. Researchers, including Dr Costa, will be tasked with producing data on complex systems within the brain and developing computational models of these systems.

The project was coordinated by the Calouste Gulbenkian Foundation in Portugal.

¹ 'Neural mechanisms of action learning in mouse models'.

Funded under the FP7 specific programme 'People' (Marie-Curie Actions).
http://ec.europa.eu/research/information_centre/search/29920
 Researchers' website:
<http://neuroaction.net/neuroaction/>

A boost for safety in rescue situations

Novel high-tech protective suits based on exciting new materials, sensors and communication technologies promise to help the professionals save lives and to minimise hazards in dangerous situations.

Rescue teams and first responders have often become victims themselves in high-risk environments such as dangerous fires, explosions or chemical leaks. Though funding of the project I-PROTECT¹, the EU is looking at new high-tech ways to protect them, with a focus on firefighters, mine rescuers and chemical rescue teams.

Specifically, the project is developing an intelligent 'personal protective equipment' (PPE) system that provides crucial information and helps safeguard well-being. Many of these teams are exposed to environments with scorching temperatures, dangerous substances, limited humidity or not enough air to breathe, raising the number of injuries and fatalities among their ranks.

To enhance protection against these conditions, the PPE system

is exploiting cutting-edge textiles and materials based on nanotechnology, combined with gas and temperature detectors. Within the textiles, the system also integrates physiological sensors that measure respiratory rate, heart rate and body temperature. Another major feature is that the system can automatically report all environmental and body readings back to command and control centres through advanced communications.

To achieve its aims, the team of 16 partners from seven countries first identified end-user needs and technical requirements. It then worked on designing and integrating the sensors as well as on developing new textiles based on carbon nanotubes. Significant progress was also made in building the envisioned communication system with the help of leading technology company Motorola.



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After extensive testing, the project is now working on standardisation and legislation related to the new technology. It is actively disseminating its valuable results in order to encourage their exploitation and the development of new commercial products. The newly developed PPE system will be ergonomically designed to achieve safety, comfort, and high-quality performance.

Once the system reaches the market, its impact on reducing occupational injuries and disease across the EU is expected to be significant. It will contribute radically to the growth of the European PPE market and to the development of the European Research Area (ERA) in industrial safety. It will bring relief

to both rescuers and victims, reducing the number of injuries and saving lives.

The project was coordinated by the Central Institute for Labour Protection — National Research Institute in Poland.

¹ 'Intelligent PPE system for personnel in high-risk and complex environments'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP).
<http://cordis.europa.eu/marketplace/search/offer/11095>
 Project website: <http://www.i-protectpl.com>

BIOLOGY AND MEDICINE

New treatment may lead the way to fighting obesity and diabetes

Two professors believe they may have a promising lead from which to develop a new treatment for obesity and diabetes.

The I2MOVE¹ project is led by two Imperial College London professors: Christofer Toumazou from the Department of Electrical and Electronic Engineering, and Sir Stephen Bloom from the Department of Medicine. The professors' combined expertise in bioengineering and endocrinology is leading the way in creating a device that mimics the response of the vagus nerve, which connects the brain to organs such as the tongue, pharynx, vocal chords, lungs, heart, stomach

and intestines. Their device is designed to suppress the appetite of a patient.

With a Starting Grant from the European Research Council (ERC) of over EUR 7 million, the four-year project is already making headway. They have developed a hormone combination using glucagon and 'glucagon-like peptide 1' (GLP-1), which plays a key role in regulating blood-sugar levels and helps reduce appetite. This may form the basis for a new treatment for obesity and diabetes in the future.

Glucagon works in opposition to insulin, preventing the storage of glucose in fat deposits and the liver, and raising blood-sugar levels. GLP-1 stimulates the release of insulin to lower blood sugar and also acts on the brain to reduce appetite.

Fighting obesity, a condition considered by the World Health Organization (WHO) as one of the greatest public health challenges of the 21st century, is the main objective of the project. Over 23 % of Europeans are regarded as obese and the health costs alone accounted for more than EUR 10 billion in



2010. Existing treatments, such as surgery, are deemed to be rarely effective, which is why the I2MOVE research team believes that electrical stimulation of the vagus nerve could be efficient when combined with intelligent recording. This is an intelligent implant which records vagal signals associated with hormone release during eating. It is designed to stimulate the nerve to modulate these signals to better regulate appetite.

Professor Bloom, together with his research team, set out to identify whether glucagon and GLP-1 infused into the blood might work together to reduce appetite. In his study, 16 volunteers were given a sequence of four treatments: glucagon, GLP-1, glucagon and GLP-1 in combination, and saline as a control. The order of the treatments was determined at random. Each treatment was then administered via a drip over a period of two hours. After the first hour and a half, each volunteer was offered a meal. Researchers recorded how much they ate and measured their energy expenditure and blood-sugar levels. The results revealed that subjects ate 13 % fewer calories after being given the two hormones in combination compared with saline, but no significant difference was

detected after taking either hormone on its own.

Volunteers treated with a glucagon/GLP-1 combination consumed significantly less food, according to Professor Bloom. These results replicate the team's findings in animals, suggesting that a glucagon/GLP-1 combination may be a promising lead from which to develop a new treatment for obesity and diabetes.

'Thirteen per cent is a big reduction in food intake by anyone's standards, but our experiment is only an appetiser,' he stresses. 'An effective future treatment will need to suppress appetite in the long term, so we next aim to establish whether the effects can be sustained to lead to real weight loss.'

The project is coordinated by the Imperial College of Science, Technology and Medicine in the United Kingdom.

¹ 'Intelligent implantable modulator of vagus nerve function for treatment of obesity'.

Funded under the FP7 specific programme 'Ideas' (European Research Council). <http://cordis.europa.eu/news/search>35674>
Project website: <http://www3.imperial.ac.uk/bioinspiredtechnology/research/i2move>

Engineering plants to produce vaccines

Producing pharmaceuticals in plants is potentially easy and efficient compared to conventional production methods. The ease of plant engineering and the significantly lower production costs could guarantee success for plant-generated vaccines against animal and human diseases.

Plants are increasingly being explored as alternative production systems for recombinant proteins. Technological advances allow either transient expression methods or the establishment of permanent plant lines that stably produce target proteins.

The main objective of the EU-funded PLAPROVA¹ project was to exploit plant expression systems for screening a range of vaccine candidates. Project partners focused on the development of vaccines against important livestock diseases

such as avian influenza and Bluetongue.

Delivery and expression constructs based on various plant viruses, such as the 'cowpea mosaic virus' (CPMV) and the 'tobacco mosaic virus' (TMV), were utilised for transient expression of vaccine antigens in plants. The CPMV system was refined to allow the expression of multiple polypeptides at the same time within one plant cell.

Using 'Bluetongue virus' (BTV) capsids in tests, it was demonstrated that at least four proteins could be expressed simultaneously in a controlled manner. These successfully assembled into 'virus-like particles' (VLPs), demonstrating their functional capacity. Overall, scientists managed to express VLPs consisting of a single polypeptide species and more complex, multi-chain VLPs in plants.

BIOLOGY AND MEDICINE



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Following extensive purification from plant tissue, assembled VLPs were administered to

experimental animals. The aim was to determine the antigenic and immunogenic properties of these plant-expressed VLPs.

Complex VLPs from BTV were shown to protect sheep against viral challenge. Similarly, a plant-expressed 'foot-and-mouth disease virus' (FMDV) polyepitope was successfully used to vaccinate guinea pigs against FMDV.

An important achievement by the project team was the expression of candidate prophylactic vaccines against 'human papillomavirus' (HPV) and influenza virus, using a novel

membrane protein (M2e) as an immunogen.

Scientists also managed to tackle the prior toxicity of 'porcine respiratory and reproductive syndrome virus' (PRRSV) proteins expressed in plants. For this purpose, they engineered proteins to reduce their toxicity and genetic instability while retaining their immunological properties.

Overall, the PLAPROVA project demonstrated that it is possible to transiently express high levels of proteins in plants that could subsequently be used as vaccines. The low production

costs of the method will have important economic benefits for both the pharmaceutical industry and farmers.

The project was coordinated by the John Innes Centre in the United Kingdom.

¹ 'Plant production of vaccines'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).
<http://cordis.europa.eu/marketplace>search>offers>6375>
Project website: <http://www.plaprova.eu/>

Bioelectronic devices for biomedical applications

The integration of nanostructures and enzymes into three-dimensional (3D) catalytically active and electrically conducting nanobiostructures could find biomedical and diagnostic applications.

Bioelectronic devices have huge scientific and practical importance for basic science as well as possible applications in medicine, the high-tech industry, the military, etc. The integration of biomaterials with electronic elements, such as electrodes, chips and transistors, yields hybrid systems that may function as biofuel cells, biosensors and bio-computing devices.

However, one of the main obstacles facing bioelectronics lies in the poor electronic communication between the biocomponents and the electronic elements.

The ultimate technological goal of the EU-funded 3D-NANOBIODEVICE¹ project was to generate a hybrid bioelectronic system that could work in various biomatrices, such as blood, serum and plasma. From a scientific perspective, partners sought to understand the fundamental principles allowing for the control of electron transfer reactions between gold nanoparticles (AuNPs), carbon nanotubes and their 3D assemblies, and different bioelements.

For this purpose, researchers chose to nanowire redox enzymes

— enzymes responsible for reduction-oxidation reactions, such as the oxidation of carbon to carbon dioxide — with AuNPs or carbon nanotubes, perform proper surface modifications, and use redox complexes. To produce such bioelectrodes with superior characteristics, their performance was initially modelled mathematically and the results obtained from these calculations were compared with experimentally determined parameters.

The consortium successfully fabricated glucose and oxygen-sensitive three-dimensional bioelectrodes,

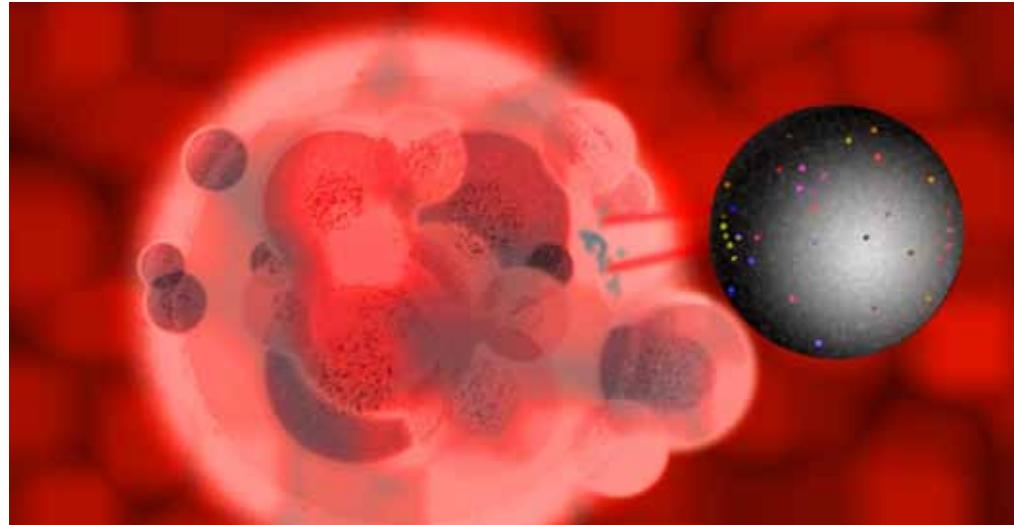
which were used as biosensors, as well as bioanodes and biocathodes of biofuel cells. Biosensors were connected to electronic units comprising a low-power radio transmitter, a voltage amplifier and a micropotentiostat, all powered by biofuel cells. The signals from these hybrid biodevices, which corresponded to varying concentrations of bioanalytes, were transferred to a computer for processing.

A novelty of the project was a proof-of-principle demonstration of functional self-powered wireless biodevices for continuous glucose and oxygen monitoring in different biomatrices. This is expected to improve quality of life and enhance patient safety in relation to chronic diseases, such as diabetes.

The project was coordinated by Malmö University in Sweden.

¹ 'Three-dimensional nanobiostructure-based self-contained devices for biomedical application'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP).
<http://cordis.europa.eu/marketplace>search>offers>10999>
Project website: <http://www.mah.se/3Dnanobiodevice>



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SOCIAL SCIENCES AND HUMANITIES



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Science education gets a revamp across Europe

Studies have shown that the proportion of students studying science in universities across Europe has decreased over the last decade, particularly in physical sciences. But an EU-funded project is keen to change all that with the collaboration of 11 European countries.

The EUR 3.8 million project ESTABLISH¹ aims to create authentic learning environments for science students aged between 12 and 18 years.

The scientific community (academic and industry), policy-makers, parent groups, science education researchers and teachers have been brought together to drive change in the classroom. This will be achieved by developing and implementing innovative 'Inquiry-Based Science Education' (IBSE) units and teacher education programmes, and adapting them to each country across Europe.

The project is led by Dublin City University in Ireland and coordinated by Dr Eilish McLoughlin. The long-term aim is to generate greater interest in science subjects at school, improve the take-up of science at high school level, and also increase the number of skilled graduates for employment in science and technology.

'This project will be informed by authentic experiences of science from outside the classroom and therefore the involvement of industry plays a key role in this initiative,' stresses Dr McLoughlin.

A number of topics from the science curricula have already been selected, and working in consultation with local partners in each of the 11 participating countries has facilitated the development of new learning materials and resources. Dr Sarah Brady, the project manager, emphasises that 'this process has enabled the ESTABLISH team to work closely with teachers to understand what their needs, expectations and requirements are when teaching science by inquiry, while also opening up a connection between science taught in the classroom and science carried out in industry.'

SOCIAL SCIENCES AND HUMANITIES

ESTABLISH has also developed a number of education programmes to help teachers adapt and adopt the new materials into their own teaching programmes.

'This has been a challenge in that there are so many variations of teacher education across Europe, but we have been able to identify certain frameworks and criteria to facilitate teacher education at both in-service and pre-service levels,' says Professor Christina Ottander from Umeå University who leads

the development of teacher education programmes for in-service teachers.

The resources and the teacher education programmes that have been successfully implemented across Europe have focused on developing authentic experiences in science. The project hopes this will help to stimulate learning and promote intrinsic motivation among students, as well as identify career opportunities in science and technology.

The project was coordinated by the Dublin City University in Ireland.

- 1 'European science and technology in action: Building links with industry, schools and home'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Science in society'.
<http://cordis.europa.eu/news > Search > 35749>
Project website: <http://www.establish-fp7.eu/>

United in diversity: how to live with difference in Europe?

Nowadays, European cities are witnessing unprecedented levels of migration and population change. In an era of super-mobility and super-diversity, how do people develop the capacity to live with difference? This question is asked by Professor Gill Valentine, a social scientist financed by the European Research Council (ERC).

Prof. Valentine's research is particularly pertinent in these times of economic crisis, as history has shown a hardening of attitudes towards 'others' in difficult periods. Within the framework of the LIVEDIFFERENCE¹ project, she will collect a unique set of data on everyday understandings of difference in the UK and Poland with a view to informing and giving nuance to European policies and strategies in the field.

'Most of the writing about new urban citizenship is based on the assumption that contact with "others" necessarily translates into respect for difference. This needs to be nuanced: many everyday moments of contact between citizens may not actually represent encounters at all,' explains Prof. Valentine.

With her team, she wants to identify what kind of encounters produce 'meaningful contact' that actually changes values and translates into a more general positive respect of others. To address this question, she is focusing on 'micropublics', i.e. sites such as libraries and sport clubs, where people from diverse backgrounds are brought together and can learn new ways of relating to each other.

'The capacity to live with difference confronts all countries of

the EU, but there are some distinctions to make,' notes Prof. Valentine. She distinguishes two important categories: the countries which are former colonial powers (such as the UK, the Netherlands, France and Spain) and post-communist states in Eastern Europe (such as Poland, Latvia and Czech Republic). For the former, the challenges of multiculturalism have been faced since the post-war period. In contrast, it is only since 1989 that the homogeneity of former communist states has been significantly unsettled by contact with 'others'.

From Leeds to Warsaw — from research to politics

Prof. Valentine's programme of research aims to collect empirical data in two cities which she believes are representative: Leeds (UK) and Warsaw (Poland). Her research team is using innovative tools to collect testimonials such as audio-diaries — to capture informants' reflections on their everyday live encounters with difference — and time-lines built on in-depth life history interviews.

Her approach includes spatial experimentation. 'With the help of ergonomics experts, movement therapists and architects, we aim to identify the types of activity and characteristics of



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particular spaces where meaningful contact can be produced or facilitated,' she explains.

'I have opted for a multidisciplinary approach, combining expertise from different fields including geography, urban studies, planning and sociology,' she adds. The outcomes of the project will also leave a legacy beyond academic research. 'I already have a collaborative relationship with the UK Equality and Human Rights Commission and I expect strong interest from Polish government bodies and NGOs who are developing equality legislation and support for minority groups for the first time following their accession to the EU,' continues Prof. Valentine.

On her EUR 2.1 million ERC Advanced Grant, she stresses that 'the ERC funding has been hugely important in enabling me to develop an interdisciplinary team of researchers at different career stages to address the important societal challenge of how we might develop the capacity for difference. It has enabled us to work with a range of non-academic

stakeholders and communities in both the UK and Poland which I hope will help us to generate findings that make a difference from the local to the European scale.'

Looking forward, Prof. Valentine plans to organise a two-day international conference in May 2014 where her findings will be showcased to European academics and 'stakeholder' dissemination workshops. In parallel, public exhibitions will also be organised in London, Warsaw and Brussels over the course of the year.

The project was coordinated by the University of Sheffield in the United Kingdom.

- 1 'Living with difference in Europe — making communities out of strangers in an era of super-mobility and super-diversity'.

Funded under the FP7 specific programme 'Ideas' (European Research Council).
<http://erc.europa.eu > Project and results > ERC Stories>
Project website: <http://livedifference.group.shef.ac.uk/>

SOCIAL SCIENCES AND HUMANITIES



Help for young people in a changing world

In today's rapidly changing world, young people face a number of tough challenges in society and employment. However, help may be just around the corner as an EU-funded project investigates what the education system is doing, and how it could bridge the capability gap.

Most people have learned to expect that lifestyles change from one generation to the next. Some believe that the world has now begun to change at an exponential rate. Today's young people are facing more rapid economic, cultural, demographic and technological changes, on top of evolving local labour-market demands and regional inequalities, all of which are having a huge impact on their lives.

The WORKABLE¹ project, with EUR 2.3 million in EU funding, is looking at the match — or mismatch — between young people's skills and competencies and changing labour-market demands. The idea is to promote a progressive impact on youth policy in Europe. This policy is focused on tackling vulnerability and discrimination amongst youngsters in their transition from school to work.

The project also addresses the difficulties faced by young people on their way from education to work or to apprenticeship. It is looking at the problem of youth unemployment, how institutions of the educational and vocational training systems in Europe tackle

these problems, and the underlying political strategies.

Led by Professor Hans-Uwe Otto of Germany's Bielefeld University, researchers will also explore how educational strategies are implemented and assess whether they really enable young people to convert their knowledge and skills into marketable capabilities, thereby acting as fully participating and active citizens.

Research is being carried out in three phases. First, institutional vocational and labour-market policies are being mapped, analysed and compared across all educational regimes. Second, case studies are being developed to uncover the conceptions, aspirations and practices of local actors implementing educational and training programmes. Finally, quantitative secondary analyses of national and European longitudinal data are being undertaken to reveal how effective our educational strategies have been at enhancing economic performance and closing the capability gap.

Project partners say their work will build on and expand the state of the art in educational, economic,



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sociological and political theories, remaining both flexible and broad in scope. At the same time, it will lay the foundations for solving concrete problems, by enhancing opportunities, and developing the capabilities of young people.

Policy-makers should be particularly interested in the rigorous comparative approaches being taken by the WORKABLE project, which will clarify the impact of local, regional and national contexts and create a new, wide-ranging theoretical understanding of the functioning of educational and welfare systems throughout Europe.

For educators, WORKABLE will suggest more appropriate training and education strategies that enable young people to cope with the economic and social challenges of the emerging knowledge economy and society. This could mean a shift away from specialised skills towards broader, more analytic generic skills. In addition, technical and routine activities could move towards more autonomous work.

On the scientific level, WORKABLE is likely to provide new theoretical

and empirical tools for studying capability provision. A key focus will be the project's work to standardise databases and thus improve the transferability of national practices and experiences.

Finally, the project partners believe their research will offer a fair progressive understanding of the transition process from school to work, which takes into account the growing difficulties faced by vulnerable young people. This could change the political agenda and provide youth with a chance, and a solid perspective, in feeling like young adults who are valued in society.

The project was coordinated by Bielefeld University in Germany.

¹ 'Making capabilities work'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Socio-economic sciences and humanities'.
<http://cordis.europa.eu/news > Search > 35764>
 Project website:
<http://www.workable-eu.org/>



How ageing impacts economic growth

How does ageing affect our productivity? When is a good time to retire? European researchers took a biology and life-cycle-based approach to address these and other questions related to ageing, retirement and productivity.

The EU-funded project LEPAS¹ has advanced a new way of thinking about the relationship between the biological process of ageing and modern dynamic

macroeconomics. Researchers set up models, based on a novel life-cycle approach, to investigate how ageing affects health, human capital formation,

SOCIAL SCIENCES AND HUMANITIES

migration flows and productivity in EU Member States.

The framework was used to observe and explain a number of related factors, such as the education gradient, and how these impact the macroeconomy. The economic life-cycle model developed provides a general framework for examining ageing in the biological sense and ascertaining how it can be applied to decisions surrounding retirement.

Being able to assess how ageing affects productivity offers

insight into the optimal retirement age from the perspective of both individuals and society. The project's research also has the potential to inform immigration-management policies and promote knowledge on national approaches to investment in health care.

Other areas investigated by the LEPAS project include the impact of an ageing society on education, technical progress and long-term economic growth. A number of scientific reports were produced. These covered topics such as

historical evolution of retirement age and retirement duration, immigration and social security, life expectancy and long-run growth, and healthcare demand and supply.

With Europe's countries facing the challenges of economic crisis and an increasingly older population, the LEPAS initiative could not be more timely. Project results are expected to boost social science research and facilitate better approaches to decision-making in areas relevant to better welfare, growth and competitiveness.

The project was coordinated by the Gottfried Wilhelm Leibniz Universität Hannover in Germany.

- 1 'Long-run economic perspectives of an ageing society'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Socio-economic sciences and humanities'.
[http://cordis.europa.eu/marketplace > search > offers > 10521](http://cordis.europa.eu/marketplace/search>offers>10521)
 Project website:
<http://www.lepas-fp7.de/>

Climate change and cultural heritage

Climate change threatens many aspects of our world, including our cultural heritage. The museums, art and buildings that give Europe its identity must be preserved by mitigating its effects.

Not much is known yet about how climate change will damage Europe's cultural artefacts. As part of the EU-funded CLIMATE FOR CULTURE¹ project, researchers aim to investigate these effects and develop strategies to prevent them.

The focus is on assessing the risk of damage and the potential economic consequences, and on sustainable preservation practices. A large multi-disciplinary team from Egypt and Europe, as well as leading institutes in

climate modelling and whole building simulation, are working on the project.

For the first time, researchers are connecting high-resolution climate change scenarios with the simulation of entire indoor environments. In this way, the impact of outdoor climate change on historic buildings can be modelled. Work has started on these scenarios, with the identification of important climate factors and the validation of tools.

Some of the experimental monitoring techniques being used include laser speckle interferometry and three-dimensional (3D) microscopy. The researchers have also begun to classify buildings in both regions into categories such as churches or museums.

Climate risk maps are being developed to analyse regional climate effects on the 'performance' of buildings, for instance their energy use. In addition, new algorithms will optimise the

control of relative humidity and temperature indoors.

Ultimately, the managers of these historic buildings will be better equipped to preserve the structures. And the solutions obtained for the buildings in these regions could be applied to those in any other similar climatic zones. The simulations could also be extended to other sectors like agriculture, fisheries, tourism, construction and even insurance.

The project is coordinated by the Fraunhofer Institute for Material and Beam Technology in Germany.

- 1 'Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
[http://cordis.europa.eu/marketplace > search > offers > 10605](http://cordis.europa.eu/marketplace/search>offers>10605)
 Project website:
<http://www.climateforculture.eu/>



ENERGY AND TRANSPORT



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A vision turns into reality in the development of electricity networks

Europe's vision for the development of electricity networks, which can significantly reduce the sector's environmental impact and allow consumers to play a part in adjusting the system, has become a reality, thanks to the EU-funded ADDRESS¹ project.

The ADDRESS consortium proposed this five-year project in answer to a Call under the EU's Seventh Framework Programme, in the energy area, for the 'Development of interactive distribution energy networks'. The aim of the Call was to better integrate renewable energies and distributed generation into distribution grids while making full use of customers' demand flexibilities through appropriate economic signals such as real-time pricing.

ADDRESS set out to make the electricity networks of the future flexible, accessible, reliable and economical, as per the vision of the SmartGrids European Technology Platform. To this end, the project team has developed technical solutions at the consumer's premises and at the power system level, which allow domestic and small commercial consumers to take part in 'Active Demand' (AD) programmes — enabling consumers to change their own demand for electricity upon the request of an aggregator, through economic incentives, as well as to offer services on the energy markets and to the electricity system players.

The ADDRESS project team believes AD is one way to solve constraints and support the development of 'renewable energy sources' (RES) through the flexibility it can offer, and thus to provide economic benefits for consumers.

A comprehensive commercial and technical framework has already been developed for Active Demand and a pilot study has been completed in Italy, while other studies are currently being carried out in France and Spain. Smart appliances, smart plugs to control traditional appliances and an energy management box that receives aggregator's signals (and manages home appliances accordingly) have been set up in households. ADDRESS systems have also been installed in medium-voltage control centres and on the network.

The ADDRESS consortium, comprising 25 partners from 11 European countries, have selected their test sites based on the different climates — for example, heat in Spain versus cold in France. Different equipment and usage patterns were used which, with the different network topologies and acceptance conditions, are expected to validate the entire concept.

Marina Lombardi, who is assisting the project coordinator in Enel Distribuzione says: 'Having completed tests in Italy, we are currently testing the system in around 300 homes in Spain and about 30 in France. Homeowners agree to test the system with us, encouraged by the incentive to save 20% on their energy bill in Spain, and

by an incentive of EUR 50 when joining and an additional EUR 0.50 (in gift vouchers) for every AD request in France.'

The equipment installed in homes allows owners to receive aggregator's signals and have their demand adjusted accordingly by the energy management box.

'We will be relying on questionnaires, personal interviews and diaries in order to gauge the experience of our consumers, and how their life is adapting to this new system,' Lombardi concludes.

The total budget for the project was EUR 16 million, with EU funding of EUR 9 million.

The project is coordinated by Enel in Italy.

¹ 'Active distribution networks with full integration of demand and distributed energy resources'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.
<http://cordis.europa.eu/news/search?35727>
Project website: <http://www.addressfp7.org/>

Crops for energy

Improved harvesting and processing techniques for non-food bioenergy crops promise to promote sustainability and create a whole new energy industry for Europe.

Non-edible crops are proving very important in the drive to create more sustainable energy options in Europe and in many other parts of the world. The EU-funded project EUROBIOREF¹ is studying the whole process of transforming these crops into biomass. It has brought together 29 organisations, academics and industry players from 14 countries to investigate this process.

To begin with, the project team grew different plants such as cardoon, giant reed, miscanthus, switchgrass and willow in test fields in order to study their use as biofuels. It also raised different oil crops such as castor, rapeseed and safflower. Specific locations were chosen for growing the various crops, such as Greece for safflower and Poland for crambe.

In parallel, the project recently oversaw the construction of a new pilot plant in Norway to process lignocellulosic materials. The facility, considered a key achievement of EUROBIOREF, has demonstrated excellent results for transforming giant reed, miscanthus and switchgrass into quality biomass.

The project's work has also led to filing eight new patents related to the conversion of vegetable oil, promising more efficient energy options for the near future. This was followed by the establishment of an online tool to calculate the social, environmental and economic impact of the new biofuels.

Another important achievement has been the articulation of six different scenarios of biorefineries and their value chains, all of which



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integrate the project's results and concepts. The next step in this respect is to conduct life-cycle assessments of the value chains, including related socio-economic issues, logistics, process design and large-scale development.

Dissemination of the project's positive results is taking place through the EUROBIOREF website and a supporting 20-minute video, also available online. In addition, a EUROBIOREF summer school has been launched in Italy to inform academics and industry leaders about the latest exciting results and improved technologies. The project is expected to spur innovation and

create around 200 000 jobs, particularly through new biorefineries in rural areas, adding an important pillar to the EU economy.

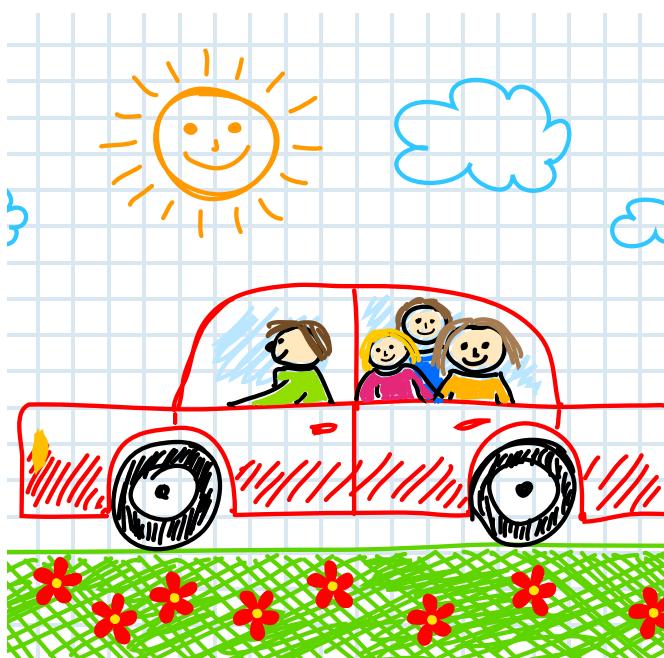
The project was coordinated by CNRS in France.

¹ 'European multilevel integrated biorefinery design for sustainable biomass processing'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.
[http://cordis.europa.eu/marketplace>
 search > offers > 10573](http://cordis.europa.eu/marketplace>search > offers > 10573)
 Project website: <http://www.eurobioref.org/>

New car engine is cheaper and greener

A substantial improvement in the energy efficiency of road transport is needed to meet European energy goals. In response to this challenge, EU-funded researchers have developed an innovative 'internal combustion engine' (ICE).



In the near future, the classic ICE will remain the primary drive technology for cars and vans. However, these light-duty vehicles are a major source of greenhouse gas emissions — they account for around 15 % of the EU emissions of carbon dioxide (CO₂).

For this reason, the EU-funded POWERFUL¹ project was established. The 'powertrain' includes a car's engine, transmission and other components that generate power and deliver it to the road surface. Motor vehicle manufacturers, suppliers and leading research institutes pooled their expertise in this project.

The POWERFUL project's objectives included developing new concepts that would substantially reduce CO₂ emissions from passenger cars. In particular, partners set out to conceive an advanced gasoline engine characterised by low cost and emissions. At the same time, the project team aimed to identify the optimal engine architecture for lower cost, and smaller and lighter components.

During the project, three major development areas were combined for spark-ignition engines: turbo-charging, direct injection and variable valve actuation. These technologies promote the downsizing of engine components and improvements in the engine's energy-conversion efficiency.

ENERGY AND TRANSPORT

The new design was optimised using a small family car equipped with a 1.4 litre engine. Computer simulations enabled the POWERFUL project to choose the best compromise between fuel consumption, startability, performance and flexibility. Initial results indicate that a possible fuel reduction of 9 % can be achieved with the new engine.

Further work will continue on assessing the novel engine's performance, fuel consumption and CO₂ emissions. By achieving all of its objectives, the POWERFUL project will realise the concept of a light-duty, environmentally enhanced vehicle. Looking ahead, this car will be able to meet the next stage of environmental limit values for

pollutant emissions, thereby improving our air quality and well-being.

The project is coordinated by Renault in France.

- 1 'Powertrain for future light-duty vehicles'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Transport (including aeronautics)'. [http://cordis.europa.eu/marketplace>search>offers>10484](http://cordis.europa.eu/marketplace/search>offers>10484)
Project website: <http://www.powerful-eu.org/>



Improving design of offshore wind turbines

Offshore wind turbines currently face high operating and maintenance costs. Scientists have substantially enhanced their design and monitoring to reduce costs and improve reliability.

The development of renewable energy alternatives to fossil fuels is a key EU goal. Harnessing wind to generate power is hoped to make a significant contribution to efforts in this direction. Onshore electricity production using wind turbines has gained important ground. Offshore production faces unique technical considerations that have, to date, resulted in high operation and maintenance (O&M) costs and limited market uptake.

Scientists initiated the RELIAWIND¹ project to change the paradigm of how wind turbines are designed, operated and maintained for a new generation of wind energy systems to impact both the offshore and onshore markets. The project is focused on analysing reliability and identifying key failure modes leading to new designs with O&M costs

similar to those for onshore wind turbines.

During the current reporting phase, scientists finished identifying six critical components of 'wind turbine generators' (WTGs): pitch mechanism, frequency converter, yaw system, control system, generator and gearbox. They also defined the five most important failures of each system and their mechanisms (previously not disclosed to industry). Better models of failure propagation resulted in optimisation of the Advanced WTG Health Monitoring System. The System is used to generate maintenance activities and their scheduling based on more than 100 input signals from a single WTG.

All results were integrated into a set of tools for condition-based maintenance of wind turbines and wind



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farms. 'Supervisory control and data acquisition' (SCADA) standards were followed and specific software modules extended the simulation platform (virtual demonstrator) to exploit project results. The latter was built and tested for proof of concept.

Thus, RELIAWIND has proposed a system architecture for offshore WTGs consisting of a modular design that better withstands harsh environmental conditions and facilitates faster and more cost-efficient maintenance. In addition, it has improved monitoring systems for more accurate diagnosis of failures and combined them with failure-prediction algorithms for preventive maintenance scheduling. Commercialisation should decrease

costs and maintenance while increasing the reliability of both offshore and onshore WTG systems.

The project is coordinated by Gamesa Innovation and Technology in Spain.

- 1 'Reliability focused research on optimizing wind energy systems design, operation and maintenance: tools, proof of concepts, guidelines & methodologies for a new generation'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'. [http://cordis.europa.eu/marketplace>search>offers>10461](http://cordis.europa.eu/marketplace/search>offers>10461)
Project website: <http://www.reliawind.eu/>



Cheap fuel from sugar cane

Second-generation biofuels may hold one of the keys to boosting Europe's goal of becoming more energy and resource efficient by 2020. The CANEBIOFUEL¹ initiative paved the way for the world's first cost-effective and commercially viable process for converting sugar-cane biomass into fermentable sugars.

Second-generation biofuels are made from lignocellulosic biomass from sugar cane and offer a promising clean alternative to existing fossil fuels. However,

a number of hurdles currently prevent second-generation biofuels from being commercialised and fully exploited.

ENERGY AND TRANSPORT

Sugar-cane bagasse, the fibrous material by-product of crushed stalk, as well as sugar-cane tops and leaves (straw) are examples of lignocellulosic biomass. The EU-funded CANEBIOFUEL project aimed to advance the current state of the art by creating new fundamental knowledge about these components.

The key objective was to develop a scientific and technological platform for converting sugar-cane biomass into fermentable sugars and to further integrate this process through the existing production of first-generation ethanol. For this purpose, partners planned to acquire a deeper knowledge of the structural components of sugar-cane biomass and of the impact of pretreatment and enzymatic hydrolysis.

Pretreatment involves opening the lignocellulosic fibre structure and exposing it for subsequent enzymatic hydrolysis. Hydrolysis introduces an enzyme catalyst that releases the fermentable sugars from the more complex carbohydrates. The aim of the CANEBIOFUEL project was to identify which part of sugar-cane biomass was the most acceptable for an enzyme-based conversion technology to produce biofuel.

After collecting over 200 tonnes of sugar cane in Brazil, consortium partners used chromatographic and spectrometric methods to analyse the chemical compositions of biomass fractions. Experiments on the treatability of the sugar-cane fractions revealed that straw

was easier to hydrolyse and ferment, most likely reflecting its different composition and morphology to bagasse. Importantly, CANEBIOFUEL was able to narrow down the best-performing enzyme 'cocktails' required for optimal conversion of these materials to bioethanol.

As expected, cost modelling showed that it is difficult to match the ethanol cost in first-generation sugar-cane conversion without subsidies. However, it was found that the production cost of second-generation ethanol is comparable to EU starch-based ethanol production, indicating it could be economically viable.

The outcome of the CANEBIOFUEL project has

important ramifications for the energy industry. It was found that a typical sugar-cane harvest in Brazil could produce up to 90 million tonnes of straw, indicating a massive fuel potential for this sugar-cane 'waste'. Most importantly, ethanol fuel production could significantly increase without using more land.

The project was coordinated by Novozymes in Denmark.

¹ 'Conversion of sugar cane biomass into ethanol'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.
[http://cordis.europa.eu/marketplace>search>offers>10463](http://cordis.europa.eu/marketplace/search>offers>10463)

Storing hydrogen in solid form for mobile application

Hydrogen is typically stored in compressed gas or liquid form. Scientists developed solid-state hydrogen storage materials to address the needs of the transport and stationary energy-supply sector for low-pressure, low-volume hydrogen storage.

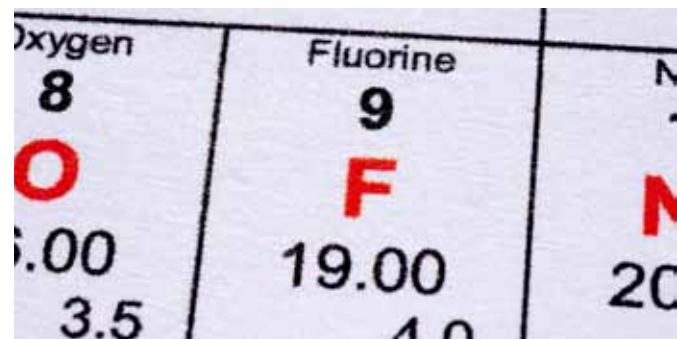
Nature's solar, wind and water resources are promising candidates to help relieve dependence on a dwindling supply of fossil fuels whose combustion is increasingly associated with global climate change. However, these alternative energy forms are plagued by some of the same issues facing fossil-fuel-based energy, namely inconsistent supply (changing over time) and uneven geographical distribution.

Hydrogen is the most abundant element in the Universe and could solve both those problems. However, it is difficult to store at room temperature at the density and compactness required for mobile applications. Scientists launched the FLYHY¹ project to develop novel materials and processes for hydrogen storage in the solid state.

FLYHY focused on modifying high-hydrogen-capacity materials by substituting some hydrogen atoms with halogens (fluorine, chlorine,

bromine and iodine) using preparation processes that could be scaled up commercially. The goal was to achieve high storage density, fast hydrogen-loading and -unloading speeds, and operation temperatures compatible with fuel cells based on a 'proton exchange membrane' (PEM).

Several promising borohydrides were investigated, including lithium borohydride (LiBH_4) and calcium borohydride ($\text{Ca}(\text{BH}_4)_2$). Substitution of the BH_4 groups was evaluated for the various halogens, and the resulting compounds were characterised according to the desired properties. Fluorine substitution in calcium-, lithium- and sodium-based reactive hydride composites (RHCs) and the expected lowering of hydrogen release temperatures were observed. Optimisation of reaction temperatures, pressures and additives is expected to yield reaction pathways that maintain the high storage capacity and



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cycling stability of the parent compounds.

Life-cycle analysis and comparisons of fuelling costs support the competitiveness of solid-state hydrogen storage with conventional compressed gas or liquid technologies — with one caveat. Raw materials must be obtained in bulk from large-scale industrial suppliers rather than in volumes of a few grammes from fine-chemicals suppliers. However, the effect of lower purities must be assessed, too.

FLYHY made important progress in the development of solid-state hydrogen storage materials with storage densities, rapid hydrogen cycling and temperatures compatible with integration with fuel cells for mobile and stationary

applications. Hydrogen's potential to replace fossil fuels as a clean, renewable and secure energy source may be one step closer to large-scale realisation.

The project was coordinated by Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research in Germany.

¹ 'Fluorine substituted high-capacity hydrides for hydrogen storage at low working temperatures'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP).
[http://cordis.europa.eu/marketplace>search>offers>6762](http://cordis.europa.eu/marketplace/search>offers>6762)
Project website: <http://www.flyhy.eu/>

ENERGY AND TRANSPORT

Greener car technology reduces emissions

Increased electrification of on-board car systems in standard vehicles can save up to 20% in fuel consumption and minimise emissions. This promises to create a greener and cleaner environment and help to combat climate change.

Environmentally friendly technology has burgeoned in recent years, particularly in the road transport sector. However, since market penetration of electric and hybrid vehicles is slow, it is important to upgrade the technology of conventional vehicles, too.

Road transport is the second largest producer of greenhouse gas (GHG) emissions in Europe and the EU-funded project EE-VERT¹ set out to address this challenge. The project worked on running a car's auxiliary systems on clean electricity produced from heat energy and braking power, as well as from solar cells integrated within the vehicle. It envisioned a reduction of 10% to 20% in fuel consumption while

maintaining a highly favourable cost-benefit ratio.

To achieve this aim, the project team built a highly efficient energy-management system, powering systems such as steering and air-conditioning through electricity rather than mechanised fuel-led power. The concept of energy recovery showed a significant reduction in carbon dioxide (CO₂) emissions, thanks to novel advanced electronic controls and to the activation of required systems only on demand.

New components in the prototype vehicle include intelligent alternators and a novel generator that operates on an optimal 40 volts for maximum efficiency between 70% and 80%. This has been

coupled with a 40-volt lithium-ion (Li-ion) battery, combined with an ultra-efficient battery-management system and voltage-warning mechanisms.

Another key accomplishment has been the design of the DC/DC converter to interface between two voltage levels, as the 14-volt power supply is still required for some vehicle components. The project team also developed an electric vacuum pump to replace the mechanical brake-boosting system, as well as a fuel pump to enhance engine performance and minimise fuel circulation.

Lastly, the project team studied the safety implications of a dual-voltage architecture to ensure that the technology does not pose any hazards. If all these advances are adopted in combination, today's vehicles may become up to 20% more efficient without radical changes to major components. This



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will lessen our dependence on fossil fuels and contribute to a greener environment while we develop the next generation of clean cars in the coming years.

The project was coordinated by Mira Ltd in the United Kingdom.

- 1 'Energy efficient vehicles for road transport'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Transport (including aeronautics)'.
<http://cordis.europa.eu/marketplace/search>offers>10446>
 Project website: <http://www.ee-vert.net/>

Accelerating the pace of particle physics research

Scientists have carried out the start-up phase of a planned particle accelerator complex in Germany. As one of the largest planned EU infrastructures, the facility will foster cutting-edge research.

The Facility for Antiproton and Ion Research (FAIR) is a planned particle accelerator complex. It will be an integrated system of unprecedented quality providing high-energy and high-intensity beams of ions of stable and unstable elements. In addition to facilitating cutting-edge research in several fields of physics, applications such as radiological risk assessment for manned space missions and novel energy-production strategies will also be on the research agenda.

As the largest research infrastructure on the 2008 European Strategy Forum for Research Infrastructures (ESFRI) Roadmap

to move into implementation phase, the new complex is truly a pioneering endeavour. The EU-funded project FP4-FAIR¹ covered the preparatory phase of FAIR construction. No technical work was included in the work packages. It focused on strategic, legal and financial matters, including governance and management, as well as coordination of research and accelerator construction. The project was a joint effort by 11 ministries and funding agencies and 14 research institutions.

EU funding enabled the consortium to quickly form the international project team whose



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work led to incorporation of FAIR GmbH, as well as the signing of the FAIR Final Act and FAIR Convention, the intergovernmental agreement. Important activities within the start-up phase of FAIR GmbH included the development of contract management for the corporation as well as a business management contract with the host lab GSI (Helmholtzzentrum für Schwerionenforschung GmbH). Financial management and project management protocols were also developed, as was a system for coordinating research and accelerator experiments.

With important EU financial support, FAIR established the organisational, managerial, strategic and governance foundations

necessary for implementation of the FAIR particle accelerator research complex. Coordinated access to the state-of-the-art facilities will no doubt have significant impact on the understanding of particle physics and on relevant applications.

The project was coordinated by GSI in Germany.

- 1 'Facility for antiproton and ion research'.

Funded under FP7 specific programme 'Capacities' under the theme 'Research infrastructures'.
<http://cordis.europa.eu/marketplace/search>offers>10050>
 Website of the Facility for Antiproton and Ion Research: <http://www.fair-center.eu/>



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Conserving biodiversity for the future health of the planet

In 2006, the UN called upon fisheries management organisations worldwide to identify vulnerable ecosystems, assess the impact of bottom fishing in these areas, and close them to bottom fishing unless conservation and management measures were established to prevent their degradation. Following up on this resolution, the CORALFISH¹ project addressed the lack of data on how fish use their habitats in deep sea by developing new tools and methodologies.

The project partners also assessed the interaction between corals, fish and fisheries, and then used this information to develop monitoring and predictive modelling tools for ecosystem-based management in the deep waters of Europe and beyond. They also looked at coral systems that had been damaged by human activity such as deep-sea trawling, and drew attention to the need to protect them from further damage.

The project was coordinated by Dr Anthony Grehan, who specialises in deep-sea ecology and conservation at the School of Natural Sciences of the National University

of Ireland. He worked with a consortium of 16 partners comprising deep-sea fisheries biologists, ecosystem researchers, modellers, economists and a fishing industry SME, representing 11 countries from across Europe.

'There is a pressing need to produce concrete proposals for the improved management of deep-sea fisheries and other resources while taking into account the need to conserve biodiversity. Implementation of such policies relies on information that is in short supply in the offshore and deep sea,' Dr Grehan explains.

The project's budget was EUR 10.8 million, of which EUR 6.4 million came from the European Commission. This enabled, for the first time, extensive mapping of new coral areas in Iceland, France and the Azores, and the quantification of coral habitats there and in three other areas — off the west coast of Ireland, the Eastern Norwegian Sea and in the Ionian Sea (Italy). This information was then used to develop 'state-of-the-art' models to predict where corals (and other vulnerable species such as sponges) could be found in the global ocean.



ENVIRONMENT AND SOCIETY

Predicting the whereabouts of corals will help policy-makers understand how best to use marine space for fishing, telecommunications cables and mineral exploration while also protecting the environment. This is in line with a proposed new EU Directive establishing a framework for maritime spatial planning and integrated coastal management.

'The need to develop the tools and a strategy for the implementation of maritime spatial planning has become increasingly urgent. This is because of human activity in the deep sea, which is expanding, for example, in fishing, oil and gas exploration, as well as potential mineral mining. Therefore, competition for deep-sea resources has become more intense while the need to ensure adequate conservation of

biodiversity and genetic variety is a priority for the future health of the planet,' Dr Grehan says.

In support of the quantification of deep-sea habitat, the project is the first European effort to develop standardised video analysis for deep sea-floor mapping, having developed the 'Customisable Video Image Observation Record' (COVER) software — elements of which have been incorporated into software available from the French Research Institute for Exploitation of the Sea (Ifremer).

Although CORALFISH has now ended, elements of the project will carry on into the Horizon 2020 Framework Programme for research and innovation. Further results from

the project will be published in a 'special edition' of *Deep-Sea Research Part II: Topical Studies in Oceanography* due out in early 2014.

The project was coordinated by the National University of Ireland, Galway in Ireland.

- 1 'Assessment of the interaction between corals, fish and fisheries, in order to develop monitoring and predictive modelling tools for ecosystem based management in the deep waters of Europe and beyond'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
<http://cordis.europa.eu/news/search?35685>
Project website: <http://www.eu-fp7-coralfish.net/>

Better detection methods for vine disease

Accounting for 65% of the world's production, Europe is a leading producer of wine. But this backbone of our agriculture is threatened by 'phytoplasma', a disease which severely damages vine productivity. The VITISENS¹ project has developed a cheaper, quicker detection method to help wine-growers tackle this issue.

Europe's finest wines are valued by consumers all around the world so any threat to production must be contained. 'Flavescence dorée' (FD) phytoplasma is responsible for a destructive and dangerous grapevine disease that severely damages plant productivity and has a significant economic impact. Already widespread in Italy and France, where its impact is considered catastrophic, FD incidence is rising rapidly in other European countries. Despite mandatory national and EU control measures, it is demonstrating a clear epidemic pattern that threatens to engulf

European wine-growers and vine-nursery 'small and medium-sized enterprises' (SMEs).

Funded under FP7, the VITISENS project set out to make FD detection easier, faster and more affordable. The disease is proving difficult to detect and identify, requiring molecular laboratory methods which, although accurate, cost up to EUR 100 per sample and take three weeks to produce the results. For these reasons, such methods are only used when visual inspection has identified phytoplasma symptoms. If infected vineyards are

not destroyed or material from them is used for grafting, the epidemic can spread very quickly.

The VITISENS project has developed a low-cost, portable diagnostic kit that can be used by EU wine producers and vine plant nurseries to detect FD phytoplasma. The project's sampling and diagnostic tools make it possible to detect FD phytoplasma in less than an hour and at lower cost per sample — about EUR 10.

During the last two years, VITISENS has created a procedure for sampling the material needed, established a protocol based on seasonality effect and designed a sample treatment protocol optimised with a DNA extraction method using laboratory methods — 'Loop-mediated isothermal amplification' (LAMP) — adapted for conditions in the field.

This diagnostic kit can be used in combination with the VITISENS reader, a portable hand-held device which amplifies DNA or RNA sequences at a constant temperature of 65°C. A fluorescence technique is then used

to detect the product resulting from the LAMP reaction. If the fluorescent dyes used together with the LAMP agents start to fluoresce as they bind with double-stranded DNA, this indicates that the samples are infected. Emission levels are measured by the VITISENS optical detection system and results are shown immediately on the LCD screen.

Completed at the end of May 2013, VITISENS promises to increase SME competitiveness in the wine industry by responding to the need for a rapid in-field test for FD phytoplasma disease. According to the project's own market survey, 65% of end-users are interested in a quick, cost-effective and reliable device.

The project was coordinated by the Department for Environment, Food and Rural Affairs (Defra) in the United Kingdom.

- 1 'Cost-effective hand-held device for rapid in-field detection of flavescence dorée phytoplasma in grapevines'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Research for the benefit of SMEs'.
http://cordis.europa.eu/wire/search_submissions?RCN=36928
Project website: <http://www.vitisens.eu/>



Cleaning up Europe's former industrial zones

Over the last three centuries, industrialisation in Europe has left much pollution in its wake. Now, a new cost-effective method for removing pollutants from the ground in related areas could help rehabilitate former industrial regions.

Contaminants in Europe's soil and water threaten the environment and the health of humans, animals and plants, prompting the EU to support efforts to explore new, more cost-effective solutions to remedy this problem. The EU-funded project UPSOIL¹ introduced a new, economically viable solution to remedy soil and groundwater pollution.

The project worked on developing new technology for rapid on-site biochemical remediation of organic contaminants. It conducted tests and modelled treatment processes around sites in Belgium, Spain, Austria and Poland, coupling biological and chemical techniques for increased effectiveness.

First, the project team studied the interaction between remediation treatments and contaminated areas to help develop better tools that are best suited for chemical-oxidation technology. It then developed an

improved, highly targeted injection system for more efficient delivery of the reactant, featuring technology that continuously records real-time distribution of the contaminants. This successfully resulted in smaller amounts of chemical agents being required and less time needed to accomplish the remediation process.

An important part of the team's effort revolved around injecting specifically developed chemical oxidants in precisely the right places. This helped ensure minimal loss of remediation reagents used in chemical-oxidation processes. The team studied different approaches to increase the efficiency of chemical treatments via a more targeted application of reagents, involving hydrophilic coated-packed reagents, hydrophobic coated-packed reagents and micelles. This helped science come closer to finding the most appropriate particles and particle sizes to improve targeting.

To optimise remediation, UPSOIL adopted a feedback-driven approach based on a monitoring control scheme that links remote sensors with a hydro-chemical computational model. The system compiles data, assesses the progress of the process and provides instant feedback to track the oxidant in real time. Results are depicted using graphs and maps that enable fine-tuning of the process as the information becomes available.

These advances have led to the development of much improved pollution remediation solutions for stakeholders such as 'small and medium-sized enterprises' (SMEs) and environmental actors. The project disseminated its results through scientific publications, conferences, policy briefs and the project website to reach a very wide audience that can market and adopt the new technology. If this happens, Europe's pockets of pollution, especially former industrial zones, could be revitalised.



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The project was coordinated by Tecnalia in Spain.

- 1 'Sustainable soil upgrading by developing cost effective, biogeochemical remediation approaches.'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'. [> search > offers > 10970](http://cordis.europa.eu/marketplace)
Project website: <http://www.upsoil.eu/>



Self-powered wireless sensors and network for smarter, greener buildings

Europe is leading the way in its policies and sustainable energy solutions, but more needs to be done to help the building sector improve its green credentials. The TIBUCON¹ project has developed a new-generation integrated 'heating, ventilation and air-conditioning' (HVAC) system which should help match the needs of 21st century buildings.



The building sector is responsible for 35-45 % of total energy consumption in Europe, and space heating accounts for the largest share in most Member States. The three-year TIBUCON project, which received over EUR 1.5 million in EU-funding, has been developing an efficient alternative to HVAC systems found in most buildings today. It is particularly suitable for larger multi-tenant buildings.

The TIBUCON team realised that current HVAC systems are not energy efficient, requiring disposable batteries and wiring to connect the sensors with the control units and installations. In large multi-story buildings, the amount of waste and carbon emissions from these installations begins to add up.

'There could be hundreds of sensors in a newly deployed, wireless-based HVAC control system for a mid-range commercial building, generating hundreds of used batteries,' notes the TIBUCON team.

ENVIRONMENT AND SOCIETY

So they proposed to replace the kilometres of cabling and piles of battery-operated sensors with a 'Self-powered multi-magnitude wireless sensor network' (SP-MM-WSN). For example, the wireless sensors detect when a room is too hot and automatically send signals to the control unit to adjust the heat to pre-defined settings, and vice versa for cooling in summer.

Doing away with the wiring and batteries is a real breakthrough, the team suggests. Not only is it a greener solution but the cost savings are significant. Wiring alone

can represent up to 80% of the total cost of an HVAC system.

The team was keen to prove their SP-MM-WSN system will work in future constructions as it does when retrofitted in modern buildings, alongside or replacing current infrastructure. TIBUCON's system was thus scheduled for testing in two demo buildings: a newly built multi-tenant office block in Poland and an existing apartment building near San Sebastian in Spain.

'Because of the investment costs, the system is not suited

for individual houses. But in collective dwellings it's possible to monitor several parameters and to control the HVAC installations in real-time,' explains a project partner in a recent *Innovation Seeds* article.

Other advantages of the new system include reduced energy consumption and power costs, lower emissions and waste generation in buildings, and it will be less invasive. It will also come with more flexible wireless infrastructure, more reliable hybrid power sensors, greater comfort — thanks to real-time temperature monitoring

— and a more efficient overall HVAC system and management.

The project was coordinated by Mostostal Warszawa in Poland.

- 1 'Self-powered wireless sensor network for HVAC system energy improvement — towards integral building connectivity.'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT).
<http://cordis.europa.eu/news/search/35757>
Project website: <http://www.tibucon.eu>

Major pan-European study conducted on ocean acidification

More than 160 researchers across 10 European countries joined together in what is being hailed as the first international project to focus on ocean acidification and its consequences.

According to the EPOCA¹ project partners, ocean acidification research was still a relatively new field when they initiated the project four years ago. Concerns had arisen after evidence showed that over the last 250 years the ocean had absorbed around a third of the carbon dioxide (CO_2) released due to human activities. These higher CO_2 levels affected the ocean chemistry, increasing the acidity of sea water. Ocean acidification is therefore often referred to as the 'other CO_2 problem'

— developing alongside climate change as a consequence of CO_2 emissions.

As a result, the EPOCA team conducted research to uncover the biological impact of CO_2 in the ocean and discovered that 10% of Arctic surface waters will become corrosive to shells and bones in less than 10 years. Further analyses of the Mediterranean coastal habitats also revealed that around 30% of marine plants and animals could be lost by the end of this century.

However, scientists found that something could be done to counteract the effects if measures were taken to offset the impact of CO_2 emissions. They predicted that these countermeasures could, over the long term, lower ocean pH significantly. This important finding spurred a large consortium of experts to implement guidelines and standards for ocean acidification research.

EPOCA has advanced scientific understanding of ocean

acidification and its impact on marine organisms and ecosystems. The project has also conducted several important studies, notably demonstrating that many calcifying organisms, such as molluscs, are adversely affected by ocean acidification.

Further studies revealed considerable variability in sensitivity between closely related species, and even between different strains of the same species. Researchers also found that some species appeared tolerant to ocean acidification in a relatively large range of CO_2 levels, while others were particularly sensitive to it. In addition, elevated CO_2 resulted in delayed larval development of crustaceans, bivalves and echinoderms.

Some species were also seen to be sensitive to ocean acidification in short-term incubations, which meant they became insensitive when kept under high pressure of carbon dioxide (pCO_2) for extended periods of time. Other studies indicated that ocean acidification narrowed the thermal tolerance of many organisms, and that the interaction of warming and acidification could alter their community structure and biodiversity.



ENVIRONMENT AND SOCIETY

A testament to the importance of these findings is that more than 200 scientific papers based on EPOCA's work were published during the lifetime of the project, representing 21% of all research articles on ocean acidification published during that period. EPOCA has also developed tools and methods that are now used by the research community and policy-makers. The results from EPOCA are expected to influence further studies on the socio-economic impacts of ocean acidification.

Dr Jean-Pierre Gattuso,
Senior Research Scientist at

CNRS-Université Pierre et Marie Curie in France, says: 'The project has garnered significant international interest and support. The EPOCA Ocean Acidification Reference User Group (OA-RUG), which was launched during the project, has rapidly evolved to include related research programmes in the UK, Germany and the Mediterranean region. Also, with the recent addition of countries outside the EU, the decision was taken to form the International Ocean Acidification Reference User Group (iOA-RUG), with support from the Prince Albert II of Monaco Foundation.'

Dr Gattuso believes it is thanks to the European Commission that European research on ocean acidification has received so much attention and increased international awareness: 'EU funding has ensured that the legacy of EPOCA carries on and research on ocean acidification continues through other European channels, such as the EU-funded MEDSEA² project. We also have further funding for a three-year project from the BNP Paribas Foundation, so our work can continue.'

EPOCA was partly funded by the European Commission for

EUR 6.5 million from a total budget of EUR 16 million.

The project was coordinated by CNRS in France.

1 'European project on ocean acidification'.

2 'Mediterranean sea acidification in a changing climate'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
<http://cordis.europa.eu/news>search>35682>
 Project website:
<http://www.epoca-project.eu/>

Understanding the environment's role in birth defects

A European study has shown that ordinary chemical pollutants can interfere with the human development process. Such man-made chemicals are part of everyday modern life.

Among the European population, reproductive health problems in men, such as poor semen quality, testicular cancer, and genital birth defects are becoming more common. These problems would seem to be a result of maldevelopment and malfunction of the

testes of the male foetus, and have therefore been suggested as evidence of a 'testicular dysgenesis syndrome' (TDS).

Accumulating evidence suggests that common environmental chemicals might contribute to

causing TDS. However, there are many obstacles to testing this scientifically, which is where the EU-funded DEER¹ project has directed its research efforts.

DEER set out to improve our understanding of the role of environmental factors in the development and establishment of human reproductive health. Initially, the project team analysed existing cohorts of human newborns and analysed their chemical exposure to establish if it was associated with the disorders.

In addition, the project used existing animal and laboratory models to study the development and function of foetal testes in order to identify mechanisms via which the reproductive disorders might arise. The complexity of real-life chemical exposures and the effects in humans were tackled using new bioinformatics methodology.

Using an approach based on 'systems biology', the project found that overall exposure to organic pollutants is higher in Denmark than in Finland, corresponding with a higher prevalence of disorders in Denmark.

Exposure to perfluorinated compounds was associated with impaired semen quality and low testosterone levels. Animal model studies showed that chemicals such as dibutyl phthalate, which disrupt testis development, also result in a TDS-like outcome. Biomarkers of such effects were established and can be used in human studies to 'see back in time' into foetal life.

The results of the DEER project have already influenced the World Health Organization's (WHO) study on the possible effects of endocrine disruptors on child health. In the future, data gathered during the project will continue to produce new analytical results that will be presented in scientific publications and to the public.

The project was coordinated by the University of Turku in Finland.

1 'Developmental effects of environment on reproductive health'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
<http://cordis.europa.eu/marketplace>search>offers>6259>
 Project website:
<http://www.eu-deer.net/>



ENVIRONMENT AND SOCIETY



Developing a clearer understanding of ocean ecosystems

The EU-funded HERMIONE¹ project has contributed much-needed data on the complexity of deep-sea ecosystems. This in turn has created a community of scientists who continue to work together to better understand the remarkable world of the deep sea and its vast diversity of habitat and life.

Europe's almost 90 000 km of coastline span the polar waters of the Arctic to the warm seas of the Mediterranean. Underneath the waves are some of the most spectacular ecosystems on Earth, including cold-water coral reefs and hydrothermal vents, supporting a huge diversity of life.

As remote as they may seem, these fantastic ecosystems are also vulnerable to the impacts of human activities and climate change. The HERMIONE project, with EUR 8 million in funding, has focused on investigating Europe's marine ecosystems, including

submarine canyons, seamounts, cold seeps, open slopes and deep basins. Scientists from a range of disciplines researched natural ocean dynamics, ecosystem distribution and interconnections, considering biodiversity, specific adaptions and biological capacity in the context of a wide range of highly vulnerable deep-sea habitats. The team included biologists, ecologists, microbiologists, biogeochemists, sedimentologists, physical oceanographers, modellers and socio-economists.

One of the key questions they addressed was how natural and

anthropogenic changes affect specific European marine ecosystems and, by extension, the goods and services on which we rely.

HERMIONE scientists were able to secure a large amount of ship time, largely funded outside of the project by national funds. There were 93 research cruises, 69 of which were longer than five days. The data collated has already been used by 103 PhD and 71 MSc students. Thus, the project has provided crucial training for these students in a range of scientific and other skills.

A major aim of HERMIONE was to use the knowledge gained during the project to contribute to EU environmental policies. The design and implementation of effective governance strategies and management plans, say project partners, require a clear understanding of the extent, natural dynamics and interconnectedness of ocean ecosystems and socio-economic factors.

Their results have indeed proved very timely and important to ongoing discussions within the European Commission, for example in the context of the revision of the common fisheries policy, as well as at the United Nations with regard to a variety of key current marine- and climate-related issues.

The project was coordinated by the Natural Environment Research Council in the United Kingdom.



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¹ 'Hotspot ecosystem research and man's impact on European seas'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'. [> search > 35709](http://cordis.europa.eu/news)
Project website: <http://www.eu-hermione.net/>



GEO technology initiative goes to central Asia

Central Asia faces critical environmental challenges which, together with partnerships from the European Union, may become the ideal ground for GEO technology deployment.

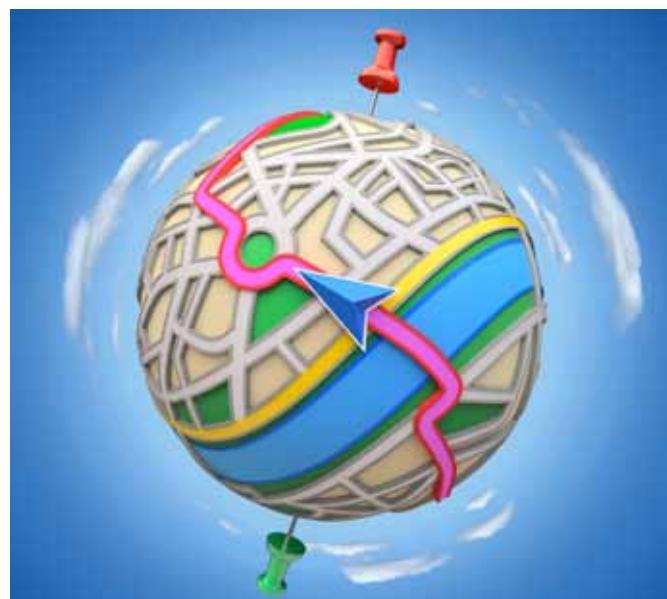
The GEOSS¹ project found that Central Asia is ideally suited for the uptake of Earth Observation (EO) technologies. Its main aim therefore was a platform solution for the region's developmental challenges. The goals attained

included a mapping of regional needs, the establishment of a regional network that will help disseminate GEOSS technologies in the region, and a training programme for stakeholders.

With these initiatives in place, the GEOCA² project increased regional governments' acceptance of GEOSS technologies for national environmental services, which include meteorology, geological exploration and natural hazard prevention.

As a Support Action, GEOCA aimed exclusively at building international cooperation in the EO technology domain. In addition, the project made a contribution to spreading affordable EO technologies and encouraging regional

ENVIRONMENT AND SOCIETY



development through its capacity-building activities.

The project was coordinated by CIDAUT in Spain.

It has also significantly advanced the goals of the 'Seville Roadmap', a document outlining the importance of resource mobilisation. The roadmap attempted to provide authorities with the necessary information to best protect society against natural or human-induced disasters, and manage energy resources and responses to climatic change. In order to do so, on a global scale, this Support Action now closes a gap in GEO technology observation networks for the Central Asian region.

- 1 'Global Earth Observation System of Systems'.
- 2 'GEO capacity-building initiative in Central Asia'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
[> search > offers > 9890](http://cordis.europa.eu/marketplace)



Plankton as a climate-change sensor

Plankton is a key component of the marine ecosystem and is sensitive to minute changes in climate. The objective of the GREENSEAS¹ project is to develop quantitative measurements of plankton responses to climate change in marine ecosystems.

To achieve this goal, the GREENSEAS project has developed multiple simulation models of plankton ecology, modelling water colour measurements, nitrogen uptake and geographical distribution of the plankton in the Atlantic Ocean.

First, the GREENSEAS project team collected historic data of plankton distribution in the Arctic, Atlantic, Nordic and Southern Oceans. The next step was to generate a database of the sea-air carbon dioxide (CO_2) flux in the South Atlantic Ocean. Finally, they collected new data characterising the physical-chemical environment and phytoplankton community structure and productivity.

Mathematical modelling of these parameters enabled scientists to generate simulations of phytoplankton behaviour in response to environmental stimuli. Minute changes in phytoplankton mass and distribution dictate significant changes in fish population. That, in turn, may require a major policy overhaul to protect fishing resources.

The successful completion of the GREENSEAS project may contribute to the continuous monitoring of climate change by using a variety of plankton as highly sensitive biosensors. The results of this study could be essential for making managerial decisions related to human health, the environment and marine life.

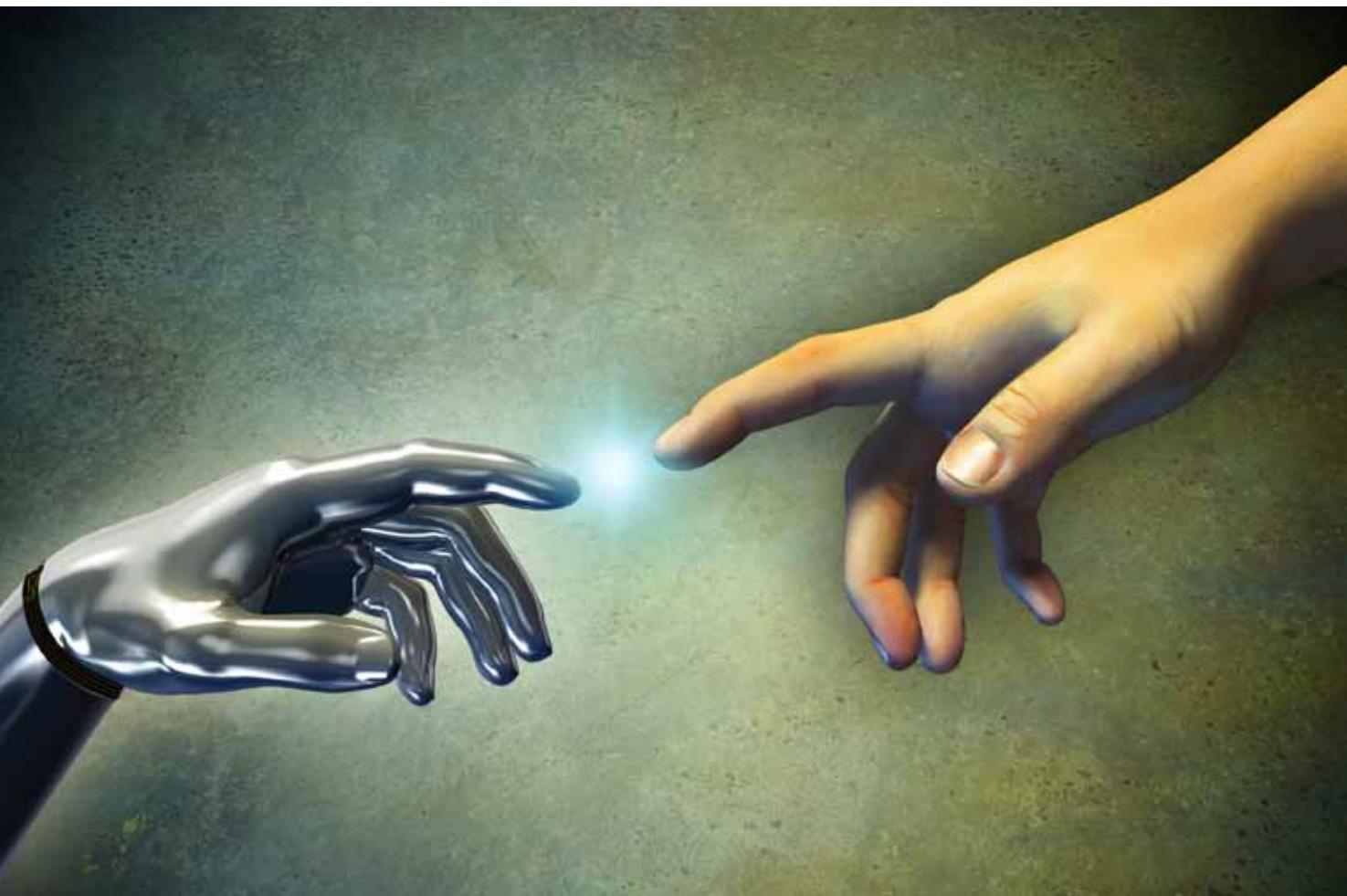
The project was coordinated by the Nansen Environmental and Remote Sensing Centre in Norway.

- 1 'Development of global plankton database and model system for eco-climate early warning'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.
[> search > offers > 10730](http://cordis.europa.eu/marketplace)
 Project website:
<http://www.greenseas.eu>



IT AND TELECOMMUNICATIONS



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Perfect skin: more touchy-feely robots

Robots could become a lot more 'sensitive' thanks to new artificial skins and sensor technologies developed by European scientists. This is expected to lead to better robotic platforms that could one day be used in industry, hospitals and even at home.

The new technological capabilities, and a production system for building touch sensitivity into different robots, will improve the way robots work in unconstrained settings, as well as their ability to communicate and cooperate with each other and with humans.

The EU-funded project ROBOSKIN¹ developed new sensor technologies and management systems which give robots an artificial sense of touch — until now an elusive quality in robotics.

According to the partners behind the research from Italy, Switzerland and the UK, it was important to create cognitive mechanisms that use tactile feedback (the sense of 'touch' or 'feel') and behaviour to make sure human-robot interaction is safe and effective for the envisaged future applications.

The artificial skin is modelled largely on real skin, which has a tiny network of nerves that sense or feel changes like hot/cold or rough/smooth. In this case, the electronic sensors collect this so-called 'tactile data' and process it using application software which has been front-loaded to include some basic robot behaviours which can be added to over time.

'Here, we opted for programming through demonstration and robot-assisted play so the robots learn as they go along by feeling, doing and interacting,' explains project coordinator Professor Giorgio Cannata of Genoa University, Italy.

'We had to generate a degree of awareness in the robots to help them react to tactile events and physical contact with the outside world,' he adds.

Kaspar the friendly robot

But robot cognition is extremely complex, so ROBOSKIN started with modest ambitions in lab tests by classifying types or degrees of touch. They created a geometric mapping using continuous contact between the test robot and the environment to build a 'body representation' — parameters by which data can be assimilated by the robot into behaviour.

Outside the lab, on the other hand, ROBOSKIN sensor patches were applied to common touch points (feet, cheeks, arms) located on the University of Hertfordshire's KASPAR robot, a humanoid robot designed to help autistic children communicate better.

'With our sensors, the robot could sense or detect contact, and the data collected formed

IT AND TELECOMMUNICATIONS

an important part of the contact classification we did — the distinction between, for example, wanted and unwanted touch,' explains Prof. Cannata.

ROBOSKIN scientists explored various technologies, from the more basic capacitive sensors in today's sensing technologies, to higher-performing transducers found in piezoelectric materials, and flexible organic semiconductors.

'We'll see more and more piezoelectric materials — which can act like sensors because they react to changes brought on by contact with an outside force — in the near future,' predicts Prof. Cannata. But sensors using organic semiconductors will be the future game-changer, he suggests, as you will be able to print the chips on different organic materials like fake skin or bendable materials, and they will eventually be much cheaper to make, once scaled up.

Promoting the prototypes

The ROBOSKIN project ended last summer but the researchers are actively promoting the

findings through scientific channels, including papers in *IEEE Xplore* and *Science Direct*, as well as calls for interest in sharing their prototypes with non-commercial research projects.

Tactile sensors are not new by any means, stresses Prof. Cannata, but ROBOSKIN has succeeded in developing a production system for building tactile sensing into different robots. These unique methods solve the decades-old problem of adding more sensory perception to robots.

'We are still at the pre-commercial demonstrator stage, but the latest version of our tactile sensors clearly have wider potential in industry as factories seek safe, cost-efficient ways of using robots in closer contact with human workers,' explains the coordinator.

Patents have been filed for parts of the team's work, but they stress that prototypes remain available for scientific research work. ROBOSKIN technology has already been integrated into iCub, the Italian

Institute of Technology's open robotics platform.

'The key was to ensure that our basic technologies would be compatible across different robotic platforms that may evolve in this fast-moving field,' notes Prof. Cannata. 'And this is what we have achieved.'

The ROBOSKIN project received EUR 3.5 million (of the total EUR 4.7 million project budget) in research funding under the EU's Seventh Framework Programme (FP7).

The project was coordinated by the University of Genoa in Italy.

¹ 'Skin-based technologies and capabilities for safe, autonomous and interactive robots'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT).
<http://cordis.europa.eu/marketplace> > search > offers > 11025
 Project website: <http://www.roboskin.eu/>

Transnational access to supercomputing

Supercomputers are powerful research tools, but access to these high-performance machines is not open to everyone in the scientific community. A European project provided hundreds of researchers with access to the latest, state-of-the-art supercomputing facilities.

High-performance computing (HPC) is also appropriately known as supercomputing. The current generation of supercomputers uses two architectures: grid and cluster computing. Cluster computing employs a large number of powerful processors in close proximity to each other. For its part, grid computing distributes its processing across a wide network of computers, often utilising the space capacity of idle machines.

Supercomputers are used to crunch mind-boggling amounts of data to perform the complex calculations required in a number of data-intensive fields. These include weather forecasting, climate research, molecular modelling, quantum mechanics and astronomy.

However, there are plenty of applications for which the power

of HPCs can be harnessed, but the researchers involved lack the computational resources or know-how. The HPC-EUROPA2¹ project sought to level the playing field and enable a greater pool of European researchers to tap into the power of supercomputers.

Funded by the Research Infrastructures action of the EU's Seventh Framework Programme (FP7), the project built on two decades of experience in providing transnational access to European HPC facilities. HPC-EUROPA2 aimed to extend HPC services equivalent to 22 million CPU hours, specialist support, scientific tutoring and collaboration opportunities to over 1000 European researchers.

All in all, HPC-EUROPA2 organised about 1000 visits lasting up to three months (plus around 80



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virtual visits) for researchers to some of Europe's top supercomputing facilities. Each beneficiary also enjoyed access to a host researcher working locally in a related field, who provided office space and specialised scientific tutoring.

In addition, a number of joint research activities were carried out in the context of the project. These sought to contribute to the development of emerging HPC programming models. They also aimed to develop basic tools that would improve the quality of information extracted from data. In addition, they strove to create a virtual cluster environment that would enable visiting researchers to make the most of their visits.

Democratising the availability of supercomputing in this way while enlarging and preparing the user base to become ready for exascale HPC is bound to promote advancement in many fields for the benefit of society overall.

The project was coordinated by Cineca in Italy.

¹ 'Pan-European research infrastructure on high-performance computing for 21st century science'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Research infrastructures'.
<http://cordis.europa.eu/marketplace> > search > offers > 10878
 Project website: <http://www.hpc-europa.eu/>

IT AND TELECOMMUNICATIONS



Video surveillance leaps into the future

By combining visual feeds from video cameras with data from different kinds of sensors, new security systems can make critical infrastructure safer. This will contribute to preventing vandalism, pre-empting terrorism, controlling property repair and upkeep costs and saving lives.

Ever since terrorist events such as the Madrid train bombing in 2004 and the London underground transport bombing in 2005, Europe has been forced to be more vigilant about its infrastructure. Current 'closed-circuit television' (CCTV) cameras can only go so far in detecting suspect or abnormal behaviour, implying a need for more sophisticated technology that would pre-empt such apocalyptic scenarios.

The EU-funded project SAMURAI¹ developed a smarter and more advanced monitoring system for infrastructure sites. The new technology is based not only on CCTV cameras but also on the use of various sensors, combining several streams of data for a more comprehensive view of what is going on. Current security CCTV

systems process video by using pre-established rules that yield a high number of false alarms. SAMURAI, on the other hand, has devised a system that detects abnormal behaviour with far fewer false alarms.

Specifically, the system takes input from CCTV cameras and different sensors that consider the movement of security staff to create a hybrid set of data for abnormal behaviour recognition. With this in mind, the project team has successfully articulated systems and tools for tracking vehicles, luggage and people in real context-based situations. Fixed CCTV cameras and mobile wearable cameras with audio and positioning sensors were used to design a more holistic system.



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Armed with high-tech data-visualisation and data-fusion capabilities, operators in the control room are able to receive valuable real-time information that is relevant to security issues and breaches. Ultimately, this innovative surveillance system will be able to provide more advanced monitoring for both inside and outside areas of important infrastructure sites. Once exploited, the technology will be very useful for monitoring airports, train stations, bus terminals, restricted areas and public places in general. This will no doubt increase safety in communities across the EU.

The project was coordinated by the Queen Mary and Westfield College, University of London in the United Kingdom.

- 1 ‘Suspicious and abnormal behaviour monitoring using a network of cameras & sensors for situation awareness enhancement’.

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Security’. <http://cordis.europa.eu/marketplace>search>offers>5970>



Internet-TV combination makes life easier

The latest advances made by an EU-funded team of researchers to marry the web and TV demonstrate how technology convergence is making our lives so much easier.

The NOTUBE¹ project has developed solutions which convert the humble TV into a personalised, interactive experience. It used to be that we turned on the TV and had no choice but to watch a specific show at a specific time.

Thanks to NOTUBE services, the television industry can catch up and we can benefit from personalised TV applications with improved data control. We can watch news programmes that are tailor-made to our tastes, or

personalise social TV and even advertising.

Over a three-year period, the NOTUBE partners developed a number of technologies. One example is the N-screen, a web application that can help small groups determine what they want to watch. Beancounter is another: it is a social web-user profiling that can bring people together, regardless of their location or the tools they use to connect. And the NOTUBE TV API gives broadcasters the means to develop novel web-based applications and systems that make TV both more interactive and better.

‘Our prototypes show that the “Web+TV” experiences which most benefit viewers and users will be those using open standards that work across different hardware, software and service providers,’ says NOTUBE member Dan Brickley, who is currently developer advocate at Google and a former researcher at Vrije Universiteit (VU) Amsterdam in the Netherlands. ‘We have tried to develop solutions that give viewers choice and flexibility.’

The unique aspect of NOTUBE is ‘linked data’: users’ information, including social networks, contacts and preferences, is stored on a cloud. Various databases and formats are used to hold and connect the data.

‘The concept of linked data allowed the NOTUBE team to set



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IT AND TELECOMMUNICATIONS

reference standards for online publishers,' Mr Brickley continues. 'This made it possible, for example, for broadcasters to create personalised news environments and online programme guides, showing users what they most want to see. Moreover, these work across devices and in multiple languages. The results and prototypes from NOTUBE are

now more relevant than ever, and show the way forward to develop personalised TV applications where the user still controls their data.'

The NOTUBE team, which was supported under the Seventh Framework Programme's information and communication technologies (ICT) activities to the

tune of EUR 9.24 million, paid particular attention to building cross-platform solutions, including a prototype recommendation engine and a sharing system that allows users to find and filter the programmes they want.

The project was coordinated by the Free University Amsterdam in the Netherlands.

- 1 'Networks and ontologies for the transformation and unification of broadcasting and the internet'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT). [> 35667](http://cordis.europa.eu/news/search)
Project website: <http://notube.tv/>



All-optical broadband ... cheaper, faster and greener

A European team of researchers is exploring new ways of using fibre-optic technology to deliver ultra-high-speed internet access to even the remotest locations in Europe, more cheaply and with less impact on the environment. It is ambitious, but innovative solutions are needed to strengthen Europe's digital economy and provide jobs.

In January, an EU-funded team of researchers announced their intention to transform future communications networks in Europe. After a period of analysis, the plan is to (re)design and later demonstrate a 'complete end-to-end architecture and technologies for an economically viable, energy efficient and environmentally sustainable future-proof optical network'.

'Simply put, the plan is to save Europe billions in broadband infrastructure costs, and provide cheaper, faster and greener access to job-creating internet services in areas where they are most needed,' explains project leader Marco

Ruffini of Trinity College Dublin's Telecommunications Research Centre (CTVR).

The 36-month project, entitled DISCUS¹, involves consortium partners from academia and industry, including leading telecom operators and equipment vendors such as Telefónica, Telecom Italia, Alcatel-Lucent and Nokia Siemens.

DISCUS tackles head-on the challenge of growing demand in Europe for better-quality data transmission and services — bandwidth-hungry video applications, telemedicine, etc. — across super-fast, always-on broadband networks.

Clean slate

'The architecture will be ultra-energy efficient, simple to operate and robust to new technology introduction — in other words "future-proofing" Europe's networks,' says DISCUS project coordinator Professor David Payne, a co-principal investigator at CTVR.

But this means taking a 'clean-slate' approach to architectural design, using optical technologies throughout the fixed network — with no distinction between traditionally separated network nodes (i.e. metro, regional, core access points). 'Using advanced optical technologies throughout will generate unimaginable bandwidth and flexibility,' predicts Dr Ruffini, an assistant professor on optical network architectures.

A unique feature will be a 'principle of equivalence' which gives all network access points equal bandwidth and service-level capability, with typical core bandwidths (from 10 Gbps to over 100 Gbps) delivered directly to the user.

That means, for example, that you would have the same high-quality online experience, capable of handling huge data loads, regardless of where you are — whether close to a core network in a city or far away in a remote village.

A further advantage of the DISCUS project's all-optical approach is that it will enable seamless integration of wireless and fixed optical networks, providing cost-effective back-hauling of mobile and wireless access network traffic, without sacrificing latency or bandwidth.

This pared-down, integrated approach will also enable a simpler, more competitive regulatory environment controlled by customers and users rather than network operators and service providers. This, in turn, supports the EU's single digital market ambitions, as communicated in its Digital Agenda for Europe initiative.

The project was coordinated by Trinity College Dublin in Ireland.

- 1 'Distributed core for unlimited bandwidth supply for all users and services'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT). [> Information Centre > search > 30033](http://ec.europa.eu/research)
Project website: <http://www.discus-fp7.eu/>



IT AND TELECOMMUNICATIONS



Tactile blisters and internet access for the visually impaired

Using ATMs and surfing the internet may soon become much easier for the visually impaired. Scientists are developing a portable and wireless touch-pad device that converts visual information to Braille.

Computers have changed the way in which information is accessed and processed, as well as the quantity of information available from a user's desktop or mobile phone. Haptic technology, relying on the sense of touch to provide user feedback, has extended the realm of digital applications through touch screens and more. However, the use of such technology, which most take for granted, is critically limited for the visually impaired.

This is about to change thanks to EU funding of the innovative project NOMS¹ — bringing together experts in the fields of materials, optics, microsystems and neuropsychology, with the support of end-users. The consortium is building on the unique properties of photo-activated nanomaterials to produce mechanical changes,

enabling Braille text and graphical information to be 'displayed' tactiley. Incorporating such materials into portable, fast-refreshed visual-aid devices will enable the visually impaired to use previously inaccessible resources such as ATMs, personal computers and mobile phones.

Scientists are focusing on nematic elastomer 'low surface-energy' (LCE) materials with excellent actuation parameters (for example, small exerted force required for tactile applications) using a 'light-emitting diode' (LED). These materials have never before been integrated into microsystem technologies, so the NOMS team is conducting truly ground-breaking work. The envisioned high-resolution and refreshable visual-aid tablet will enable visually impaired users to



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browse the internet in real time with a fast, portable and wireless device.

Scientists have already designed and tested a suitable tactile blister (a type of Braille-type tile). The first version of the transformation software that will convert visual information from the digital device to tactile on the blister is ready. Specifications for the rest of the interface between the PC and the NOMS tablet, including wireless protocols, have been defined. Investigators are currently fabricating a blister element coupled to LED arrays and micro-lenses. NOMS technology will provide a step change in the way visually impaired people interact with the digital world, with crystal-clear benefits. In

addition, the technology will open the door to a variety of other commercial applications and be an invaluable tool for neuropsychological studies of language processing.

The project was coordinated by the Spanish National Research Council in Spain.

1 'Nano-optical mechanical systems'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP). <http://cordis.europa.eu/marketplace>search>offers>11042>
Project website:
<http://www.noms-project.eu/>



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High-tech communications to the rescue

When a disaster strikes, emergency crews must communicate seamlessly with each other and with their superiors. A proposal for a new communication system plans to change this.

Ever since the advent of wireless radio communication, emergency crews have been able to respond more quickly to hazards and disasters. Yet despite major advances, communication systems still fall short in many situations as they lack interoperability, become easily overloaded in emergencies and often fail to support crucial broadband data transfer. The EU-funded project HELP¹ sought to overcome these limitations.

The project set out to create an advanced wireless system for disaster relief based on convergence of different technologies, to be used particularly in the immediate aftermath of a crisis

situation. After studying operational scenarios and deriving user requirements, it outlined needs of the system such as interoperability, networking and security. The team defined relevant concepts, such as network sharing and spectrum sharing, pointing at key technical challenges to complete its feasibility analysis.

After defining the concept and its technical implications, HELP articulated a high-level functional model of the overall solution framework based on synergies in composite radio systems. Through several workshops and consultations with stakeholders, such as mobile

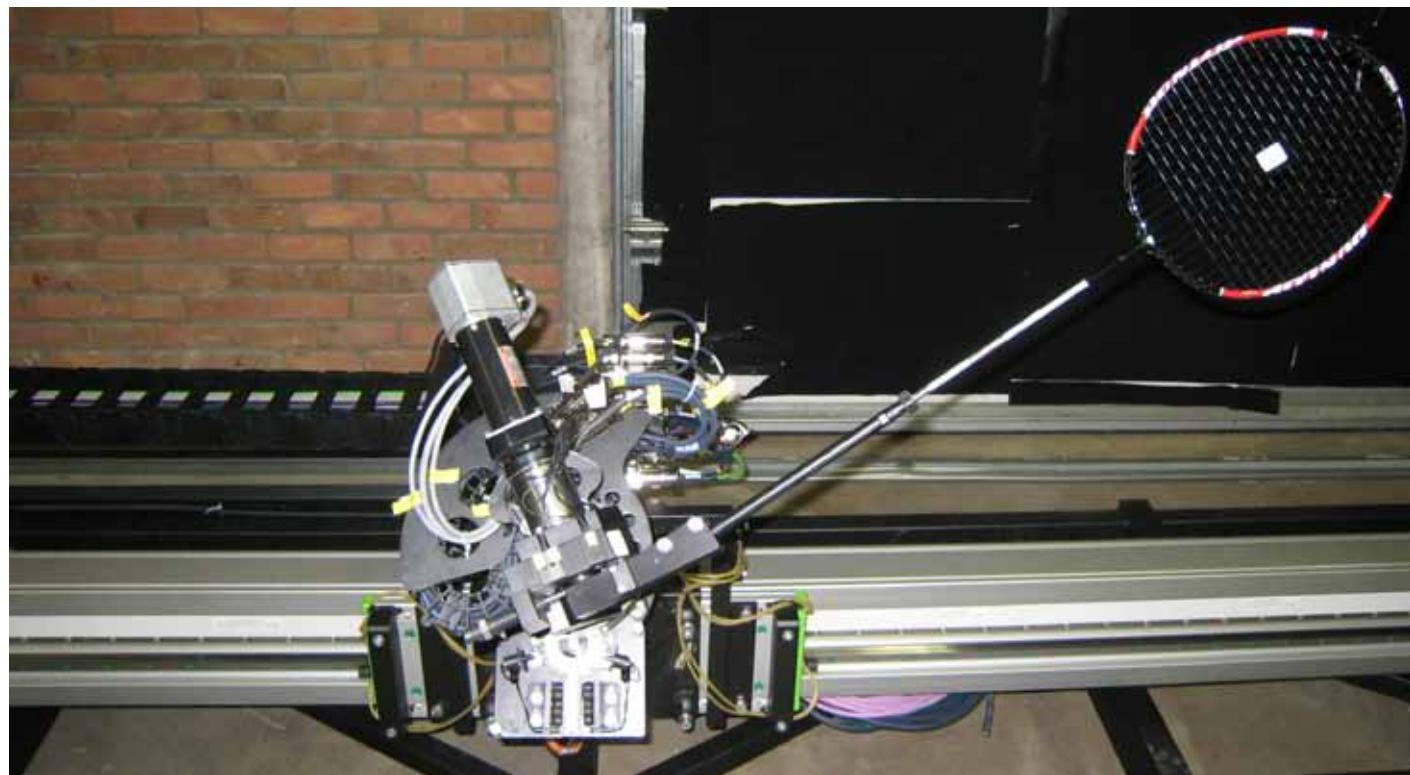
network operators and emergency services, the project team fine-tuned the proposed solution. It ensured that the system is compatible, not only with existing public safety networks, but also with public mobile networks to enhance flexibility and communication options.

Features of the system include dynamic spectrum management, dedicated bandwidth for emergency operations and an additional spectrum. Although the proposed solution requires more research, regulatory support and standardisation of issues under radio-systems authorities, it holds tremendous promise in facilitating emergency communication.

The project was coordinated by the Polytechnic University of Catalonia in Spain.

1 'Enhanced communications in emergencies by creating and exploiting synergies in composite radio systems'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Security'. <http://cordis.europa.eu/marketplace>search>offers>10723>



Badminton-playing robot tests software designs of the future

The drive to decrease the ecological impact of production machines is leading industry to focus on novel ways to incorporate energy efficiency in the designing of new products. One answer is the first-ever badminton-playing robot — designed to test a software application that optimises energy efficiency in machine design.

The robot is the result of the ESTOMAD¹ project, led by the Flanders' Mechatronics Technology Centre (FMTC) in Belgium. They have been looking at design approaches in sectors, such as agriculture and textiles, which are driven by performance and capacity rather than energy efficiency. With EU-funding of nearly EUR 2 million, the project aimed to develop a methodology, and related ICT tools, to model, simulate, analyse and optimise energy flows and losses during machine operation.

'We decided to build a badminton robot to demonstrate the new technologies we are developing. The reason we decided on a badminton robot is that we thought it would be a really convincing demonstrator; a real eye-catcher. There has never been a badminton robot, and everybody can play against it,' explains Wim Symens, Technical Director of the FMTC.

'We were able to cut down the energy consumption of the robot by 50%', Symens notes. From observing the robot, the team found that energy consumption of installed machines can

be incrementally reduced by punctual modifications, such as replacing standard electric motors with high-efficiency alternatives.

With new design schemes developed by the ESTOMAD team, machines are expected to have an average energy saving of 30% over their lifespan. It is hoped that the newly adapted technology will also help the car industry. This approach has previously been employed for products such as refrigerators and laundry machines.

Industry has already expressed interest in performing this type of energy-efficiency analysis. For example, one of the eight partners involved in the project is Picanol, specialised in high-tech weaving machine construction. It has reportedly cut the energy consumption of its existing machines by up to 15% by integrating the ESTOMAD software into its production line.

The ESTOMAD team believe that in the future engineers could use this software for machines even before they are built. Performing a virtual analysis at an early stage, they say, could provide industry with a competitive advantage.

Tom Boermans of engineering solution consultancy LMS International, Belgium, another partner in the project, says: 'A virtual approach is always the preferred one. You can even simulate strange conditions; very fast or very high temperatures. In real life, those tests are very expensive.'

It is thought that the badminton robot and the innovative software will help engineers of many different industries cut down the energy consumption of their production line, making production more sustainable while reducing the costs of their end products.

The project was coordinated by Flanders Mechatronics Technology Centre VZW in Belgium.

1 Energy software tools for sustainable machine design'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT).
<http://cordis.europa.eu/news/search?query=35724>
Project website: <http://www.estomad.org/>

INDUSTRIAL TECHNOLOGIES

Railway learning reaches higher ground

A new virtual university has been developed to improve the skills of employees in the railway sector. This will help create a more competitive and efficient rail industry.

A better railway sector in Europe can lead to a more competitive and sustainable economy, thanks to improved mobility, cleaner transport and safer infrastructure. The EU-funded project SKILLRAIL¹ aimed to improve employment in the sector. The project worked on matching graduates from different research-based education and training institutions across Europe with the needs of this growing sector.

In this context, the project designed and launched the virtual EURAIL 'European University of Railway' to create, transfer and disseminate knowledge within the sector. It defined the needs of railway stakeholders and developed training courses for high-skilled jobs in four key areas: asset management, railway dynamics, rolling stock and energy efficiency.

Significant focus was also placed on fostering gender balance in the sector, particularly since the representation of women in the transport field is low compared with the overall labour market. Another key project priority was to facilitate part-time or full-time postgraduate studies by giving specialists the opportunity to develop their skills. In this respect, the project has enhanced and expanded access to railway-related courses, in addition to improving the quality of education in the field.

After globally documenting the educational sector, the project put forward study topics not offered by existing institutions and developed novel courses based on e-learning principles. It promoted joint PhDs and international Master's degree programmes in the field by delivering an excellent array of advanced courses. In parallel, the



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project conducted a workshop on best practices in skill development for future rail professionals and another on sustainable and competitive solutions for rail mobility.

SKILLRAIL successfully catered to the evolving needs of the railway sector and reached out to young people who want to improve their skills. It underlined the need for advanced high-tech engineering to develop more robust railway systems and also disseminated valuable knowledge in this respect. The project has finally bridged the gap between the past and future of railways in Europe.

The project was coordinated by Instituto Superior Técnico in Portugal.

¹ 'Education and training actions for high-skilled job opportunities in the railway sector.'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Transport (including aerospace).
<http://cordis.europa.eu/marketplace/search/offer/10995>
Project website: <http://www.skillrail.eu/>



Sensitive bomb detector to rove in search of danger

European researchers have developed and tested a lightweight device capable of detecting extremely minute quantities of explosives from up to 20 metres away, providing an invaluable law-enforcement tool in the fight against bomb attacks.

The EU-funded OPTIX¹ team uses advanced optical technologies that can be mounted on a compact remote vehicle and then used to detect quantities of less than 1 mg of explosives. According to reports, no other research organisation or company has achieved this degree of sensitivity.

Society needs to be safe to thrive. Terrorism — as painfully highlighted by the tragic events in Madrid (2004), London (2005) and Boston (2013) — is a real threat to Europe and the world. Attacks using 'improvised explosive devices' (IEDs) appear in the news

every other day — more than 60% of terrorist attacks are carried out by the use of such explosive devices.

'Security forces demand new tools to fight against this threat,' notes the team on their website, 'and very specifically tools capable of detecting explosives at stand-off distances.'

Detecting traces of explosives at a distance of up to 20 metres can help boost security across a wide range of scenarios, suggests Alberto Calvo, Security Director at Indra in Spain, which led the



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project. 'Not only would security be enhanced, but the inconvenience for citizens would be reduced significantly through the use of a non-invasive and non-hazardous explosive detection system,' he believes.

Thanks to lasers that can precisely identify the atomic and molecular

structure of explosives, the OPTIX device can rapidly and remotely scan all objects in its field of vision, such as a vehicle, piece of luggage or any opaque container, and pick up trace residue. It is virtually impossible to handle explosives and transport them without leaving a trace: residue sticks to the surface of the objects that

INDUSTRIAL TECHNOLOGIES

transport them, as well as the hands of the people who handle them and whatever they touch.

To make the system portable, the team plans to integrate it into a wheeled platform, which could eventually resemble a bulked-up Mars Rover. As demonstrated in a video of the prototype, this platform will move along a car park or a street, for example, scanning surfaces for traces of explosives. A law-enforcement officer will control the roving vehicle remotely and monitor the data collected from the optic sensors in real time.

The OPTIX consortium, which received EUR 2.4 million in EU funding, is one of many security projects backed by the European Commission to improve

the safety and quality of life of European citizens. By the end of 2013, EU funding programmes will have financed more than 250 security research projects involving over 1500 participants from 45 countries. Funding for security research will continue to be supported under the EU's forthcoming multi-themed, multi-annual research programme Horizon 2020 (2014-2020).

In addition to the lead partner Indra, the project involved a balanced set of industrial, technology and academic partners, including: the Swedish Defence Research Agency; SMEs Ekspla (LT) and Avantes (NL); technical universities Clausthal and Dortmund (DE), and Vienna (AT), and the University of Málaga (ES); as well as the Guardia

Civil's TEDAX unit (Spanish Police, Explosives Disposal Unit, Valdemoro, Madrid) as a first-level user and institutional partner.

The security industry has one of the highest potentials for growth and employment in the EU, according to the European Commission. Already in 2011, it employed some 180 000 people, with an annual turnover of EUR 30 billion. Advances such as those by OPTIX place Europe in an even stronger position.

The OPTIX prototype has already been successfully tested in laboratory and outdoor environments, simulating real-life situations, and in various weather conditions. The team plans to increase the sensitivity,

precision and robustness of the system before making it available to European police and security forces. Commercialisation of the system is also very likely, according to the OPTIX team, with multiple applications being considered, including in the field of forensic investigations.

The project was coordinated by Indra Sistemas in Spain.

¹ 'Optical Technologies for the Identification of Explosives'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Security'.
[> search](http://cordis.europa.eu/news/search)
> 35742
Project website: <http://www.fp7-optix.eu/>



Super surfaces at your service

Every time a firefighter braves an inferno, a scientist wonders if a new material or special flame-resistant coating could be created to protect him. Today, armed with nano-composite techniques and insights into bio-based materials, new classes of smart, adaptable super-surface coatings are possible, according to European researchers.

Teams from Austria, France, Germany, the Netherlands, Slovenia and the UK investigated a new class of bio-based materials tailored to the needs of different fields, including medicine, the environment, electronics, manufacturing, and even health and safety applications.

These ground-breaking new materials are made up of extremely small layers of polysaccharides (a carbohydrate with a number of sugar molecules bonded together) coated with nanoparticles comprising other biological or mineral matter. When applied to the surface of other materials to form a

composite, the coating performs a very special role.

'The number of applications for this smart breed of new polymer compounds are boundless,' according to Dr Volker Ribitsch from the University of Graz, Austria, who led EU-funded

researchers in the SURFCELL¹ project.

The six industrial and seven academic partners recently delivered the findings of their four demonstrators in the fields of pulp and paper, cellulosic yarns, cellulose films, and filter membranes.

Improved properties

SURFCELL investigated the effects of cellulose dissolution, structuration with nanoparticles and irreversible coatings. The project targeted, in particular, so-called surface compounds — where the compounding is strictly limited to the surface of the matrix polymer material. This, they predicted (accurately), would prevent deterioration of the compound structure, or matrices holding the materials together. Under different conditions, such as intense heat, cold or through other wear, tear and exposure, the chemical properties of the material could change and weaken the bond holding the compound together.

The improved properties of these materials, such as antimicrobial activity, selective adsorption, flame resistance, electrical conductivity and barrier properties >



INDUSTRIAL TECHNOLOGIES

(for precise separation), could make them ideal for use in medical and hygiene devices, water-purification systems, as well as in the electronics industry.

'I'm confident, thanks to our open innovation approach, that our work will find its way into novel polymers and surface coatings, and will also support wider nanoscience research,' says Dr Ribitsch.

Since the SURFUCCELL team had to start from the beginning with many aspects of its work, it called for new thinking and strategies to handle nanoparticles and to design nanostructured composite materials using renewable resources.

'The further we got into the project, the more important it became that the functional coatings not only reliably serve their purpose, but

also serve the environment, which is especially good for a sustainable European industrial sector,' concludes Dr Ribitsch.

The project was coordinated by the University of Graz in Austria.

¹ 'Surface functionalisation of cellulose matrices using cellulose-embedded nanoparticles'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP). <http://ec.europa.eu/research> > Information Centre > search > 29893 Project website: <http://www.surfucell.eu/>

Unbreakable materials on the horizon

Since Leonardo da Vinci, scientists and engineers have investigated how things break or irreversibly deform, with a view to discovering unbreakable materials. This issue is at the core of Stefano Zapperi's research. In 2011, he received an ERC Advanced Grant to explore the response of materials when they are exposed to an external driving force. The long-term outcomes of his research could contribute to enhancing the safety of materials and everyday products.

As a leading expert in statistical and theoretical physics from the National Research Council in Italy (CNR), Dr Zapperi is well placed to examine the dynamics of complex materials and the size effects in fracture and plasticity.

'I have always been fascinated by the way things break differently at different scales; this has been a central problem of engineering,' says Dr Zapperi. 'The one atom-thick sheets of graphene that you use in laboratories and large pieces of architecture such as bridges do not fail in

the same way. Size effects are immensely complex phenomena and our goal is to understand how collective effects — i.e. the motion of atomic defects and cracks in materials — can impact their physical behaviour when the scale changes.'

An area where pragmatism is still king

A lot of empirical knowledge about fracture and plasticity already exists. 'Engineers, for instance, know how to prevent elevators falling, by making them much stronger than required.

These issues are already part of their everyday work but a complete theory about fracture and plasticity of materials is not yet in sight,' notes Dr Zapperi.

In the ERC project SIZEFFECTS¹, he plans to establish a universal law for failure statistics that could be applied to a large array of different materials, including metals, glass, crystalline materials, amorphous materials such as gels, etc.

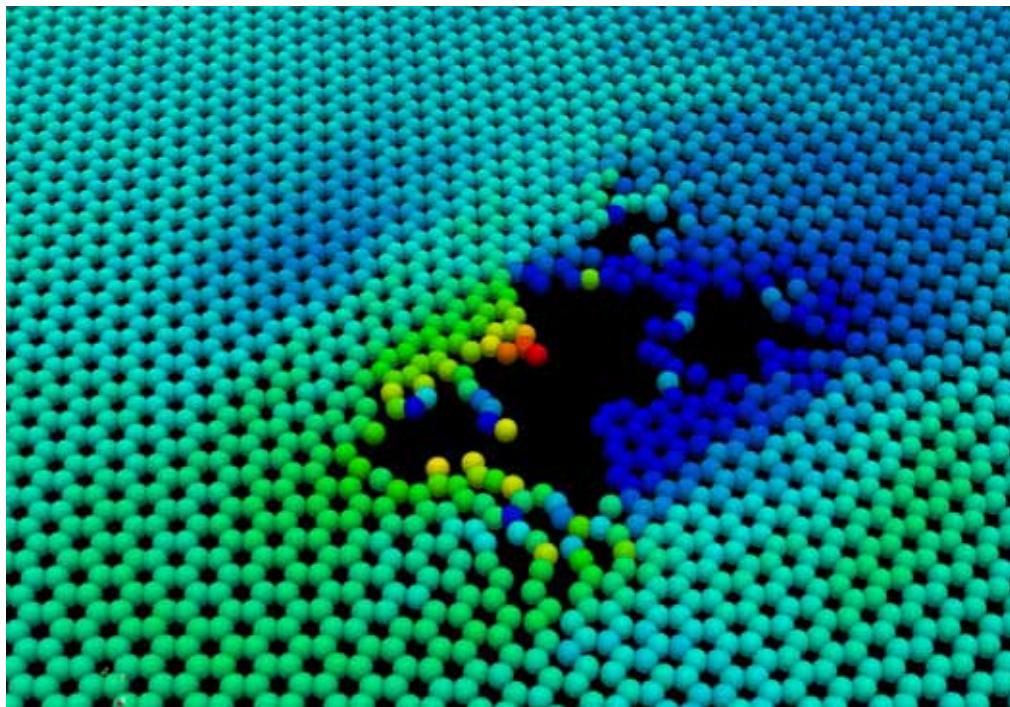
Using the example of water, which boils under a certain

amount of heat that is proportional to its volume, Dr Zapperi explains that the theories of fracture and plasticity do not follow the same proportionality principle. There is no simple way to estimate the load at which a large sample will break just by knowing the fracture load of a smaller sample. Referring to Leonardo da Vinci's wires, which are exhibited in the Milan Science Museum, he explains that on average, longer wires are more likely to possess weak parts and to fail at smaller loads. For instance, a chain will break at its weakest link. To sum up, he says 'the larger, the weaker — the smaller, the stronger'.

In contrast, the stress required to deform plastic materials (the so-called yield strength) does not depend very much on the size of the object. Micron-sized samples, however, are much stronger than bulk ones and are also less predictable in the way they deform.

By using a standard method called the 'renormalisation group' (RG), which allows the study of how the system behaves depending on its scale, the research team plans to better understand size effects in fracture and plasticity.

Dr Zapperi is convinced that his research is particularly relevant at times when we push devices



INDUSTRIAL TECHNOLOGIES



© Stefano Zapperi/CNR, Italy

Stefano Zapperi

to smaller and smaller scales. 'Understanding size effects in micron-scale ductile materials like metals could be helpful to better control fluctuations in their deformation, which is important in manufacturing microelectronic components, for instance.'

Freedom of research

Regarding the ERC funding, Dr Zapperi comments: 'A lot of our work deals with computational work. The ERC grant was a real career boost as it helped me to

hire five team members and to buy a dedicated computer cluster to make our simulations, instead of using standard desktop computers which by definition are much slower.' In terms of collaboration, he concludes: 'ERC funding allows us to make cutting-edge research and to cooperate with peers in other countries like the US or Finland. I find it quite exceptional to benefit from such freedom without being obliged to squeeze my research by pre-set priorities.'

The project is coordinated by the National Research Council in Italy.

¹ 'Size effects in fracture and plasticity'.

Funded under the FP7 specific programme 'Ideas' (European Research Council).
<http://erc.europa.eu> > Projects and Results > ERC stories
 Project website: <http://www.sizeffects.eu/>

Fast, effective manufacturing of small, complex parts

Manufacturing small batches or custom parts such as dental prosthetics can be quite costly and time consuming. Scientists have developed a technology to significantly decrease time, cost and material usage while enhancing quality.

Scientists launched the EU-funded IMPALA¹ project to develop laser-based 'rapid manufacturing' (RM) processes. The goal was to facilitate a significant increase in annual turnover among 'small and medium-sized enterprises' (SMEs) by decreasing product delivery time for complex parts with small-scale features (in the micrometres to millimetres range).

RM processes build a part by layering. Lasers can be used to melt small amounts of materials in a precise manner and with minimal heat input. The IMPALA system consisted of several key components focused on computerised automation and control of 'laser-additive manufacturing processes' (LAMPs). 'Computer-aided design' (CAD)/'computer-aided manufacturing' (CAM) and

'computer numerical control' (CNC) transformed the design into manufacturing instructions to control the laser sintering and direct metal deposition processes.

Two complete IMPALA systems were installed, one using blown-powder technology and the other powder-bed technology. Three demonstrators produced for the IMPALA project achieved impressive reduction in cycle times compared to conventional manufacturing.

A valve seat cladding was produced in just a 25-second cycle using the laser deposition process. Fast and accurate manufacturing, requiring very little post-processing and with very little material waste, resulted in an estimated 20% cost savings per part. The partners produced a Wilsident dental bridge using laser powder-bed technology with an impressive cycle time of 30 minutes per part. Currently, such components are handmade, requiring intensive labour and up to two days for delivery. While some fine-tuning is still required, the reduction in time is impressive. Finally, a 'metal leading-edge' (MLE) was produced using laser processing and milling, with a significant reduction in cycle time and material waste. Cost was also reduced by up to 50%.

IMPALA demonstrated distinct advantages over LAMPs in terms of cycle time, material usage and cost — particularly for small batches, miniature components and custom-made parts. IMPALA technology also facilitates the interruption of manufacturing to implement corrective strategies. It is expected to have a significant impact on the aerospace, automotive and medical sectors, among many others.

The project was coordinated by TWI Limited in the United Kingdom.

¹ 'Intelligent manufacture from powder by advanced laser assimilation'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 10908
 Project website: www.impala-project.eu.com



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SPACE

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Faster space rovers

Space rovers currently travel very slowly over uncharted terrain to avoid getting stuck or damaged. Novel soil-sensing technology and the possibility of a rover team should enhance risk assessment for faster data collection.

Planetary exploration with unmanned vehicles is a tricky business. Since the nature of these missions is exploratory, rovers travel into uncharted territory guided by remote-sensing instrumentation. In order to avoid getting stuck in soft sand or damaged due to collisions with other obstacles, rovers move very slowly covering only a few metres per day.

When trying to explore vast planetary objects, such speeds can prevent expensive space missions from making the most of their data collection opportunities. The EU-funded FASTER¹ project is seeking to increase rover speeds by improving hazard anticipation through advanced soil-sensing technology, control software and paired rover cooperation.

The first project period was devoted to establishing the specifications for all aspects of the project. These included the systems concept,

the mission scenarios, and the protocol for system validation and testing. All these have been finalised. In addition, the team has begun developing designs for the soil-sensing system and the scout rover test bed. A major component of the project is assessing the feasibility and performance of a collaborative 'mother' and 'scout' rover pair in which the scout assesses soil and surface conditions and the mother follows. Design concepts for the pair are currently under development.

FASTER expects to significantly enhance the scientific pay-off of capital investments for planetary exploration missions by increasing the speed at which rovers cover the terrain. Advanced instrumentation to analyse the surface and avoid hazards, as well as a novel rover-team concept — where the first analyses and the second traverses for data collection — should improve the safety and

reliability of future planetary-exploration missions. Space and defence funding often have additional benefits and FASTER is no exception. Technology for safely traversing unknown terrain in harsh environments will be highly desirable for emergency management tasks and undersea exploration as well.

The project was coordinated by the Deutsches Forschungszentrum für Künstliche Intelligenz GmbH in Germany.

1 Forward acquisition of soil and terrain for exploration rover.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace> > search > offers > 11094
Project website: <https://www.faster-fp7-space.eu/>



Processing and compressing space data

Processing digital signals obtained by spacecraft for transmission to Earth is a monumental task. Scientists are developing European technology for higher-volume, higher-speed computations.

Space missions routinely handle data that are either available once in a lifetime (research) or necessary for global security and telecommunications. Ever-increasing data flows require extensive on-board processing capabilities in order to prepare and send data to Earth. Current European 'digital signal processors' (DSPs) are reaching their operational limits and American devices are subject to export

restrictions, providing the impetus for the EU-funded project DSPACE¹.

In this context, a model of a DSP using a standard digital hardware description language — 'Very high-speed IC hardware description language' (VHDL) — has been produced. It has been designed using an innovative approach based on high-level processor modelling with LISA ADL (Architecture

Description Language) and subsequent VHDL refinement. Thanks to this approach, it has been possible to obtain a good trade-off between the project time available for design activities as against the maturity levels and consistency of the architecture produced. In addition, the necessary software tools could be generated automatically (assembler, linker, and instruction level cycle accurate simulator) from the DSP model.

In parallel to architectural description, an analysis of many of the different 'system development environments' (SDEs) currently available has been performed in order to verify whether they were adaptable to the space DSP architecture (exploiting the advantages of a mature base for DSPACE SDE). An open-source GCC-based software suite has been selected and retargeted on DSPACE's system-on-chip by means of two sub-modules.

The first module, called Glue Software, transforms open-source assembly language into DSPACE 'linear assembly' language (hardware-independent code mainly obtained by removing all optimisation and register allocations). The second one, called Code Optimiser, optimises the DSPACE linear assembly language code in relation to space DSP architecture.

In order to validate the DSPACE DSP design, both the production of

a demo board — housing a 'field-programmable gate array' (FPGA) dedicated to embody the designed IP Core — and the integration of developed SDE have been envisaged. Five different application scenarios have been defined, and benchmark performance indicators as well as the DSP validation protocol have been determined. Adoption of the 'ESA DSP SW benchmarks specification' (Next Generation Space Digital Signal Processor Software Benchmark, TEC-EDP/2008.18/RT, December 2008) led to the production of different algorithms, with a focus on data compression code, mathematical functions of interest, and factors affecting integration of DSP data-paths architecture and assembly language.

DSPACE is expected to lead to a new generation of European space DSP systems. This is in line with the aim of ensuring a competitive position for the EU space industry by means of increased capability of handling computationally intensive processes. Applications could reach many fields such as equipment manufacturing, software development and data.

The project was coordinated by SITTEL in Italy.

¹ 'DSP for space applications'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace/search/offer/10781>
 Project website:
<http://www.dspace-project.eu/>



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Pushing ahead with new forms of propulsion in space

Although chemical propulsion has typically been used to drive space exploration, the next generation of space missions requires novel methods for propelling spacecraft. One possibility explored by an EU-funded project is high-power electric propulsion that promises higher performance and affordability.

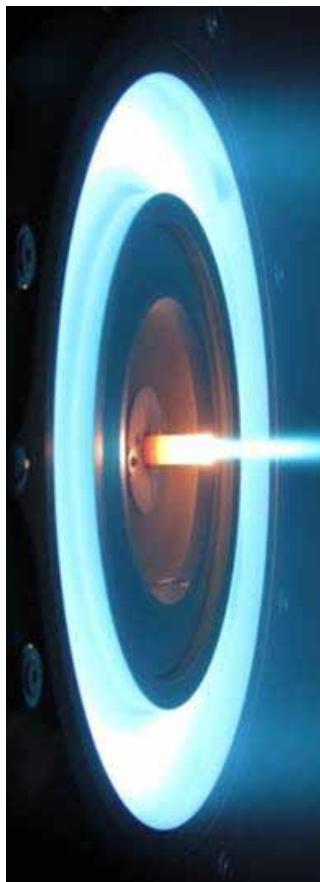
Spacecraft are typically propelled using chemical propulsion technologies although, in theory, electric thrusters offer

much higher 'specific impulse' — a measure of rocket-engine efficiency. This is partly because practical power-source

constraints in space mean that the thrust available in practice is currently much weaker than that of chemical thrusters.

However, new propulsion technologies will play a vital role in enhancing the performance and affordability of the next generation of missions carried out by the European Space Agency (ESA). They will also deliver benefits to national and international projects. >

SPACE



© Giovanni Cesaretti

HIPER¹ is an EU-funded project involving a consortium of 20 partners from across Europe. The project team helped coordinate and consolidate European research efforts to develop innovative electric propulsion and related power-generation technologies.

The researchers first carried out a critical review of past electric propulsion missions to identify this technology's strengths and weaknesses. Based on this analysis, a broad range of performance requirements were drawn up and passed on to the technology development teams.

These teams worked to develop a novel solar-power generation system using light concentration techniques, thin hi-efficiency solar cells and light or flexible substrates. HIPER also worked on fleshing out preliminary power-conditioning architectures for both the solar- and nuclear-powered electric propulsion.

One team designed, built and successfully tested a 20 KW 'Hall-effect thruster' (HET) prototype able to provide 1 N of thrust. Another team focused on gauging the state of play and determining future requirements for high-power 'gridded ion engine' (GIE) technologies, and developed and tested a new high-current cathode concept for the same thruster.

HIPER also worked on defining the most important parameters of the magneto-plasmadynamic (MPD) thrusters. A team characterised plasma instabilities in MPD thrusters, identified design solutions for instability control and validated the main design choices for these thrusters. Two MPD prototypes were built and extensively tested.

In the final stage of the project, all experimental activities started in previous phases were completed and test results collected. HIPER also carried out analyses

for missions to the Moon, Mars, Jupiter and near-Earth objects.

The partners consolidated general recommendations for high-power electric propulsion systems in a synthesis document. This document will provide some much needed thrust for the European — and global — space community's efforts to exploit the advantages of electric propulsion.

The project was coordinated by ALTA in Italy.

¹ 'High power electric propulsion: a roadmap for the future.'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace/search > offers > 6460>
 Project website:
<http://www.alta-space.com/hiper/>

High-tech garbage removal to clear the space raceway

Debris cluttering the path of valuable space satellites is on the increase. Scientists are developing a concept of a ground-based laser system to clean up the garbage and avoid collisions.

Numerous European space assets, such as satellites for communication, Global Positioning Systems (GPS) and Earth Observation (EO), are travelling around the Earth in a region called Low Earth Orbit (LEO). Unfortunately, they are not alone.

Space debris, including out-of-service satellites as well as remnants from space collisions, is increasingly cluttering the LEO. Currently, there is no effective and affordable solution for detection of and protection against medium-sized debris (from 1 to 10 centimetres in diameter). This size is particularly dangerous as it falls in a window larger than that accommodated by shields but smaller than that of objects that can be tracked. In

addition, inter-debris collisions will create even more of this undetected and dangerous space garbage.

Scientists initiated the EU-funded project CLEANSPACE¹ to protect the space environment and assets from such a chain reaction. The main objective is to define a global architecture of surveillance, identification and tracking to be used with an eventual ground-based laser protection system.

In order to prepare for integration, scientists have defined a technology roadmap of the laser system for taking debris out of orbit. In essence, a laser pulse would create a small thrust on space debris by surface ablation. This would change its course,

avoiding collision while simultaneously starting the process of atmospheric re-entry, called 'desorbitation'.

Within the first reporting period, the scientists established the project website and the internal forum for exchange among partners. Close cooperation led the researchers to define the operational concepts of the desorbitation sequence to be activated in case a collision risk is detected. Modelling of the desorbitation process was used to determine the high-level requirements of the laser-based space-debris removal system as well as to evaluate its performance.

The CLEANSPACE roadmap for development of a laser-based space-debris removal system focusing on medium-sized garbage will help protect EU space assets from collisions. In the long term, it just might enable continued space missions that would otherwise have become



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impossible due to increasing amounts of debris.

The project was coordinated by CILAS in France.

¹ 'Small debris removal by laser illumination and complementary technology.'

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace/search > offers > 10621>
 Project website:
<http://www.clean-space.eu/>

Monitoring the Arctic from above

Improved satellite technology systems are helping to monitor glaciers and icebergs in the Arctic, providing valuable information on climate change and helping the planet adapt to these changes.

Climate change is melting ice in the Arctic considerably, which in turn is raising sea levels, threatening biodiversity and altering marine conditions. The availability of several satellites over the Earth can be exploited to assess these rapid changes and help the world adapt to them. This has been the mandate of the EU-funded project MAIRES¹.

The project is developing better ways to monitor Arctic glaciers, sea ice and icebergs through radar technology, infra-red images and passive microwave data. Such information is crucial in different areas such as maritime traffic, oil exploration and gas exploration, as well as for establishing

fisheries and monitoring the environment. The project is achieving its aims thanks to strong cooperation with Russian actors, as well as Canadian and United States stakeholders in space observation, in order to document ice changes and developments.

Project priorities include validating sea-ice drift data, detecting icebergs through high-tech means, mapping changes in glacier elevations and documenting ice behaviour over time. Research conducted has revealed a dangerous reduction of glacier areas and lowering of the glacier surfaces, as well as ice-drift dynamics, in response to atmospheric wind systems. Progress was also made in



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detecting icebergs through high-resolution satellite images that surpass currently used systems.

This has led to valuable new data on Arctic glaciers and the cryosphere that are instrumental for understanding climate research and for modelling climate-change impacts. The data will also help scientists, policy-makers and the general public understand and map climate change, giving a more precise picture over the next few years. The resulting information will undoubtedly be useful not only

for adapting to climate change but also for mitigating its impact.

The project was coordinated by Nansen Environmental and Remote Sensing Center in Norway.

¹ 'Monitoring arctic land and sea ice using Russian and European satellites'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace/search/offer/10726>
 Project website: <http://maires.nersc.no/>

Massive new insight into the ionosphere

Consolidating massive amounts of unused satellite data to create a web-based resource on the ionosphere will further research in many disciplines, from the study of solar phenomena to earthquake research.

Over the years, satellites have amassed a vast amount of scientific data that could be useful in studying part of the upper atmosphere, the ionosphere. This layer of the atmosphere is crucial for understanding radio transmission, geographical positioning technology, solar radiation and geomagnetic storms. Much of the rich information we have today, however, has not been catalogued or processed.

In this context, the EU-funded project POPDAT¹ is working on enhancing data availability related to the ionosphere. In technical terms, the project is facilitating processing of data from past space satellite missions and extracting the signatures of wave-like phenomena

in the ionosphere to create catalogues and web resources.

These novel resources include wave catalogues that could reflect a more holistic view of the wave field in the ionosphere, recording such wave activity in clearer and more useful ways. The process involves data mining for travelling disturbances in measured ionospheric plasma density, atmosphere gravity waves and wave forms in electromagnetic field records.

The project has also designed an ionosphere wave service to support access to the new wave catalogues for use by experts, students and amateurs in scientific education and research. POPDAT progress and results



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have been disseminated through conferences and publications to stakeholders, and reaching out to experts and educators.

By exploiting available satellite data on the ionosphere more efficiently, many areas stand to benefit from the massive amount of untapped research. These areas include ionosphere physics, Sun-Earth interaction models, space weather, earthquake research, Earth observation and space monitoring. The project's new web portal will certainly represent a welcome addition to the European Research Area

(ERA) and to the world's scientific community.

The project was coordinated by the Technical University of Berlin in Germany.

¹ 'Problem-oriented processing and database creation for ionosphere exploration'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.
<http://cordis.europa.eu/marketplace/search/offer/10727>
 Project web portal: <http://www.popdat.org/>

EVENTS

International conference on optical communication systems

The fourth 'International conference on optical communication systems' (OPTICS 2013) will take place from 29 to 31 July 2013 in Reykjavik, Iceland.

Optical fibre is currently the most reliable and efficient solution for high-rate transmission in communication networks. In recent years, there has been a great deal of ongoing research that spans the entire protocol stack of optical networks, with representative areas including architecture of optical components, optoelectronics, wavelength routing, energy efficiency, and many more.

The conference will bring together researchers, engineers and practitioners interested in any of the communication components of an optical communication system, or the system itself.

For further information, please visit:

<http://www.optics.icete.org/>

International conference on security and cryptography

The 10th 'International conference on security and cryptography' (SECRYPT 2013) will take place from 29 to 31 July 2013 in Reykjavik, Iceland.

When transmitting messages, ensuring that their content is secured and does not fall into the wrong hands is paramount. The conference will focus on information systems and network security, including applications within the scope of the 'knowledge society' in general and information systems development in particular.

It will bring together researchers, mathematicians, engineers and practitioners concerned with security aspects related to information and communication.

For further information, please visit:

<http://www.secrypt.icete.org/>

European congress of epidemiology 2013

The 'European congress of epidemiology 2013' (EuroEpi) will be held from 11 to 14 August 2013 in Aarhus, Denmark.

Epidemiology involves studying the distribution, frequency, causes and effects of health-related states in a defined population. Based on the assumption that the environment we live in and our behaviour can influence the development of diseases, it provides data for directing public health action.

The three-day congress will focus on non-communicable diseases. A large spectrum of topics will be covered, including gene-environment interaction, reproductive epidemiology, mediation analysis, chronic diseases in low- and middle-income countries, as well as causal inference in epidemiology.

For further information, please visit:

<http://www.euroepi2013.org/index.php?id=58>

Nordic congress of cerebrovascular diseases

The 17th 'Nordic congress of cerebrovascular diseases' (Nordic Stroke 2013) will be held from 21 to 24 August 2013 in Vilnius, Lithuania.

The brain is a highly sensitive organ that crucially depends on a constant supply of oxygen and nutrients from the blood stream. Short disturbances in the blood supply may cause irreversible disabilities — or may even be fatal. In Europe, more than 1.2 million people die every year from cerebrovascular diseases such as stroke.

The conference will welcome neurologists, neurosurgeons, cardiologists, radiologists, general practitioners and other health professionals from around the Baltic Sea. It will provide an overview of the latest clinical developments and achievements in epidemiology, diagnosis, management, prophylaxis and rehabilitation of stroke in different countries.

For further information, please visit:

<http://www.nordicstroke2013.lt>

Annual symposium of architectural research

The fifth 'Annual symposium of architectural research' will be held from 28 to 30 August 2013 in Tampere, Finland.

From oil-based economic growth and ICT-based technological novelty, the drivers of urban processes and their spatial and architectural manifestations are likely to evolve drastically over the next decades. Diversity, adaptability and innovation certainly provide a positive seedbed for new ideas and practices in this regard.

Organised by the Finnish schools of architecture, the symposium is the annual gathering for research in architecture, urban design and planning. It provides international keynote lectures, high-quality research papers and networking opportunities for researchers and practitioners.

For further information, please visit:

<http://www.atut.fi/>

European Plant Science Organisation conference

The seventh European Plant Science Organisation (EPSO) conference will be held from 1 to 4 September 2013 in Porto Heli, Greece.

This biannual conference is one of the top plant-science events. It showcases the high quality of plant research in Europe and the world. This year's themes will include regulatory networks in plants; plant response and adaptation to low resource availability, biotic and abiotic stresses; the mitigating role of plants in climate change; global food security; plant-driven bioeconomy; and plant evolution.

The conference will bring together key plant scientists from academia and industry, as well as policy-makers from Europe and around the world to present and discuss cutting-edge science, plant science policy and societal issues which challenge tomorrow's agriculture.

For further information, please visit:

<http://www.epsoweb.org/7th-epso-conference-1-4-september-2013-greece>

European conference on artificial life

The 12th 'European conference on artificial life' (ECAL 2013) will be held from 2 to 6 September 2013 in Taormina, Italy.

Artificial life is an interdisciplinary undertaking that investigates the fundamental properties of living systems through the simulation and synthesis of biological entities and processes. It also attempts to design and build artificial systems that display properties of organisms, or societies of organisms, using abiotic or virtual parts.

The conference will gather researchers to discuss topics in this domain including, but not restricted to: evolutionary computation, quantum computation, molecular computation, neural computation, swarm intelligence, artificial ant systems, artificial immune systems, self-organising systems, and emergent behaviours.

For further information, please visit:

<http://www.dmi.unict.it/ecal2013/>

OnTheMove 2013

An event entitled 'OnTheMove 2013' will be held from 9 to 13 September 2013 in Graz, Austria.

Current and future software will remain focused on the development and deployment of large and complex intelligent and networked information systems. These are required for internet- and intranet-based systems in organisations, as well as for a very wide range of application domains, technologies and research issues.

Four themes will be discussed during this event: mobile aspects of computing in general; cloud-computing deployment for enterprises; infrastructure and semantics for the internet of things (aka. cyberphysical systems); and the role of community-driven and semantic IT in organisations and business ecosystems.

For further information, please visit:

<http://www.onthemove-conferences.org/index.php/about-otm-2013>

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