



European
Commission

research[★]eu

RESULTS MAGAZINE

N°39
FEBRUARY 2015

SPECIAL FEATURE

HIGH-TECH CONCEPTS TO SENSE THE WORLD



SOCIAL SCIENCES AND HUMANITIES
**REDEFINING CITIZENSHIP
IN A GROWING EUROPE**

» PAGE 22



IT AND TELECOMMUNICATIONS
**INFORMATION TECHNOLOGY FOR
PEOPLE WITH DOWN'S SYNDROME**

» PAGE 32

Published by

The Community Research and Development Information Service (CORDIS) managed by the Publications Office of the European Union
2, rue Mercier
2985 Luxembourg
LUXEMBOURG
cordis@publications.europa.eu

Editorial coordination

Melinda KURZNE OPOCZKY

The *research*eu results magazine* is published by the Community Research and Development Information Service (CORDIS) and managed by the Publications Office of the European Union. Content is prepared using several sources, including CORDIS, the Research Information Centre, ERC, as well as original material collected specifically for this publication.

The *research*eu magazines* are free of charge.

For all issues of the *research*eu results magazine* you can:

- download the PDF or e-book version
- order single paper copies
- subscribe to have every issue posted to you at <http://cordis.europa.eu/research-eu>

Disclaimer

Online project information and links published in the current issue of the *research*eu results magazine* are correct when the publication goes to press. The Publications Office cannot be held responsible for information which is out of date or websites that are no longer live.

The technologies presented in this magazine may be covered by intellectual property rights.

ISSN 1831-9947 (printed version)

ISSN 1977-4028 (PDF, EPUB)

© European Union, 2015

Reproduction permitted, provided the source is acknowledged. Neither the Publications Office nor any person acting on its behalf is responsible for the use that may be made of the information contained in this publication or for any errors that may remain in the texts, despite the care taken in preparing them. For reproduction or use of photos and any other artistic material, permission must be sought directly from the copyright holder. Excluded from this constraint are the photos and artistic material owned by the European Union.

Cover photo © agsandrew, Thinkstock



EDITORIAL

by the editorial team

SMART SENSORS FOR A MORE MINDFUL SOCIETY

It is often argued that the main difference between humans and animals lies in the formers' superior intelligence. But what we do have in common is our five senses, and the capacity to use these senses to better apprehend the world around us — at least to a certain extent.

There are many things we cannot perceive directly, and society's ever-growing reliance on computers means the latter need to be able to 'sense the world' and translate events or changes in measured properties into electrical or optical signals we are able to understand and analyse. Such sensors are slowly becoming ubiquitous, and can measure things as varied as temperature, distance to obstacles, speed, specific chemical and biological compounds, rain density, air flow, pressure, magnetic fields, movement and even sound.

According to 2014 forecasts by bcc Research, the sensor market will be worth some EUR 80 billion in 2015 and will grow by 10% each year over the next five years. It also contributes to at least 10% of the world's GDP. Research and innovation are key to gaining market shares, and scientists and engineers are now putting all their efforts into a new generation of sensing machines called smart sensors — differing from their ancestors by their capacity to proceed to advanced calculations autonomously and communicate this information wirelessly.

'The sensor market contributes to at least 10% of the world's GDP.'

Smart sensors are key to the advent of all things smart, from smart wearables to smart cars and smart cities. The EU is well aware of this potential, and has been funding a plethora of projects either focusing on or involving sensors under FP7.

This edition of the *research*eu magazine* focuses on some of the latest advances made by EU scientists in developing smart

sensors for applications as varied as medical implants, malaria diagnosis, silicon retina, air traffic control and aircraft maintenance, bacteria detection, localisation of explosive devices and noise reduction technologies.

These specials are followed by the usual sections on biology and medicine, social sciences and humanities, energy and transport, environment, ICT and industrial technologies, as well as a brand new section dedicated to food and agriculture. The latter will be featured every three issues, in rotation with the space section and another newcomer dedicated to physics and mathematics.

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



Want more information on the contents of this issue?

For online versions or information about the contributors in this issue of *research*eu results magazine*:

CORDIS

- <http://cordis.europa.eu/projects>
- <http://cordis.europa.eu/stories>
- <http://cordis.europa.eu/news>

European Research Council

- <http://erc.europa.eu>

EC DG Research and Innovation

- <http://ec.europa.eu/research/infocentre>



Focus on
Polymers and
composites rise
to new
challenges

4 SPECIAL FEATURE

HIGH-TECH CONCEPTS TO SENSE THE WORLD



- 4 Image sensors that behave like biological retinas**
- 6 Real-time malaria diagnosis
- 6 New detection technologies for bacterial pathogens
- 8 Toxic gas — sensing and filtration
- 9 Air traffic control: Safety first
- 10 Wireless sensors make aircraft maintenance more efficient
- 11 New panels for aircraft noise reduction
- 12 Biocompatible molecular sensors
- 12 New sensors can find a bomb before it's even ready to blow up
- 13 Towards medical implants powered by environmental sound waves
- 14 Utilising novel measures to enhance product quality



15

15 BIOLOGY AND MEDICINE

- 15 RUNSAFER: when sport shoes start caring for you**
- 16 EU project designs home care system for liver patients
- 17 Elucidating neural tube patterning
- 18 Study reveals new information on genetic architecture of kidney cancer
- 19 Mechanisms of malignant skin cancers
- 19 Ebola forecasting uses model developed by EU project
- 20 Brain iron levels in ADHD patients
- 21 Depth perception in humans



22

22 SOCIAL SCIENCES AND HUMANITIES

- 22 Redefining citizenship in a growing Europe**
- 23 New empirical research for accountancy
- 23 An in-depth look at banking stability



24

24 ENERGY AND TRANSPORT

- 24 Clean bill of health for electric cars**
- 25 Extending organic solar cell lifetime
- 26 Biofuel from seaweed
- 26 Reducing energy use and nitrogen in wastewater
- 27 An all-electric aircraft system model library
- 27 Greener corrosion protection for helicopters



28

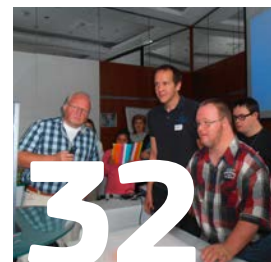
28 ENVIRONMENT AND SOCIETY

- 28 New virtual research communities to create and share data on biodiversity**
- 29 Carnivore-herbivore interplay in forests
- 30 Microbes and organic matter in arid soil
- 30 Training and research safeguards groundwater

- 31 Effect of zooplankton on ecosystems
- 31 Understanding the Arctic for first responders

32 IT AND TELECOMMUNICATIONS

- 32 Information technology for people with Down's syndrome**
- 33 All-optical information processing
- 34 Gaming technology makes its way into headsets for the visually impaired
- 35 The world's most advanced bionic hand
- 36 Faster fibre optic cable offers new era in data transmission



32

37 INDUSTRIAL TECHNOLOGIES

- 37 Innovative textiles to boost EU seaweed farming**
- 38 Photonic integrated circuits come of age
- 39 High-tech, tailored equipment for first responders
- 40 Filling in the (nanotube) gaps
- 41 Eco-friendly, long-shelf-life packaging



37

42 FOOD AND AGRICULTURE

- 42 Innovative techniques raise hope of reducing losses from cassava and yam crops**
- 43 Researchers develop tools to promote novel food potential
- 44 Largest wheat chromosome sequenced
- 45 Seaweed extracts to promote wellness



42

46 EVENTS

HIGH-TECH CONCEPTS TO SENSE THE WORLD

INTERVIEW

IMAGE SENSORS THAT BEHAVE LIKE BIOLOGICAL RETINAS

In a way, the more image sensors evolve, the more they stay the same. Imagine a security camera: it will generate huge amounts of data, even when there is nothing to film. Our eyes, on the other hand, have the ability to adapt the amount of data generated to perceived changes. If the amount of light stays the same, no data is generated. The SEEBETTER team is looking to copy this unique feature in a novel silicon retina.

Ever since the invention of the first *camera obscura* and the advent of photography in the 19th century, scientists have been fascinated by the use of light sensors to capture the world around us from the perspective of a man-made machine. Most recently, all eyes have been on image sensors relying on CCD or CMOS technology. These state-of-the-art camera devices can convert optical images into an electronic signal, and are used in applications for sectors including healthcare, automotive, media or security.

According to a recent report by MarketsandMarkets, image sensors will be worth some EUR 13.24 billion (USD 15.77 billion) by 2020. But while the fight for market share has led to considerable advances in terms of pixel size, pixel density, resolution and performance, there is still a long way to go before these technologies can go toe-to-toe with biological retinas.

The SEEBETTER (Seeing Better with Hybrid BSI Spatio-Temporal Silicon Retina) project is organised around the conviction that these technologies are dragged down by the way they produce redundant sequences of images at a limited frame rate. The Imec-led consortium

has spent the last three years trying to overcome this problem by 'realising an advanced silicon retina with the superior quantum efficiency and spatiotemporal processing of biological retinas.' In other words, they have been studying the functional roles of various retinal ganglion cells to better understand retinal vision, after which they attempted to recreate its capacity to generate data according to timely changes in the amount of light picked up.

David San Segundo Bello, coordinator of the project, accepted to discuss the state of the project, the strengths and weaknesses of the SEEBETTER technology and its potential applications, including the hypothetical impact it could have on retinal prosthetics.

★ What is the main objective of the project?

David San Segundo Bello: The objective of SEEBETTER is fourfold: to better understand the functional role of the major classes of retinal ganglion cells; to model mathematically and computationally retinal vision processing from the perspective of biology, machine vision and future retinal prosthetics; to design and build a high-performance

silicon retina with a heterogeneous array of pixels specialised for both spatial and temporal visual processing; and to use silicon back-side processing technology to increase the sensitivity of the sensor.

Each of the project partners is an expert in achieving one of these four objectives.

★ Artificial vision has been gaining momentum lately. What would you say are the main advantages of your technology compared to other existing solutions?

The first thing to bear in mind is that we need to be careful about the nomenclature. Our silicon retina is an image sensor manufactured in silicon, which works in a similar way to biological retinas. In this sense, it is very different from a silicon retina to be implanted in a patient as a retinal prosthesis.

Whilst our 'silicon retina sensor' could indeed be used in such an implantable 'artificial' retina, our project does not directly target this field of applications. I could say, however, that the main advantage in such a usage scenario would be that the sensor works in a similar way to the biological retina, so it could be 'easier' to hook it up to the



© SEEBETTER

DAVID SAN SEGUNDO BELLO

visual nerve, but this is far beyond my area of expertise so I'm merely speculating.

If by 'artificial vision' you refer to applications of image sensors in so-called 'machine vision', then the main advantage of our sensor is its larger dynamic range compared to standard sensors. Concretely, the dynamic range of an image sensor can be defined as the difference between the lowest amount of light that can be detected before reaching the noise floor of the system, and the highest amount of light before the pixel saturates. In standard sensors, increasing the dynamic range requires a lot of effort and trade-offs related to the photodetection element, the pixel readout electronics, and the control of the pixels. In our sensor, the main limitation is in the amount of pulses that can be processed, i.e. the speed of the electronics. But since no data is generated when there are no changes in the scene, this results in lower power consumption and data rates many applications could benefit from.

★ How do your silicon retinas work exactly?

A silicon retina sensor works in a completely different way from most existing CCD or CMOS image sensors. Standard image sensors generate data proportionally to the amount of light landing on the sensor's pixels. The information is in the 'amplitude' of the pixel signal and the pixels are active and read at regular time intervals defined by the frame rate and/or the exposure time. The information relevant to the application will be extracted from these pixel values for each image or frame.

Our sensor, on the other hand, is based on the 'Dynamic vision sensor'

(DVS) principle, which is itself inspired by the way biological retinas work. Instead of generating data proportional to the amount of light, each pixel is sensitive to timely changes impacting this amount of light. The data generated consists of asynchronous digital pulses, and the information lies in the amount of time between pulses. For example, a slow change in the amount of light on a particular pixel will generate pulses at a relatively slow rate, while sudden changes will generate pulses at a high rate. At the same time, if there are no changes in the scene being captured by the sensor, no data is generated.

★ How close would you say these sensors are to biological retinas?

Well naturally real biological retinas are more complex, with many different types of pixels (cells) which are also communicating with their neighbours. Such properties would be very complicated or impossible to develop with standard CMOS technology. With our project, we add some additional functionality to the pixels with respect to existing 'silicon retina sensors', but it is a small increment. Nevertheless, we are convinced that this limited functionality in comparison to real retinas can be very useful in a lot of vision applications.

Of course nothing comes for free, and these extra functionalities require larger pixels: between 10 and 20 micrometre pitches depending on the technology node and the functionality included on the pixel. In contrast, state-of-the-art standard image sensors currently feature pixels from two to five micrometres, with some manufacturers already offering pixel pitches very close to one micrometre.

★ What would be the most groundbreaking discovery you have made in your research so far?

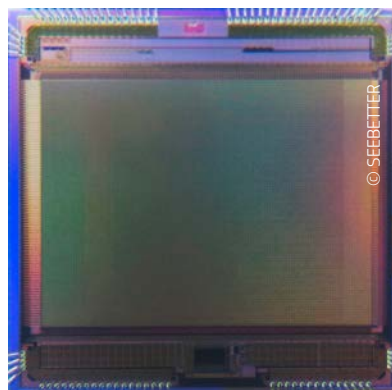
In terms of groundbreaking discoveries, our biology partner, the Friedrich Miescher Institute, is the one with the most visible results, having improved our understanding of how cone cells in the retina work. This has led to several publications in high-impact journals such as *Science* and *Cell*. With regards to the sensor itself, the University of Zurich has demonstrated the first silicon retina sensor with embedded 'standard' pixels enabling more complex visual processing and extending the utility of these sensors. Imperial College developed a hardware emulator of a retina sensor using standard off-the-shelf cameras. Finally, Imec successfully developed and implemented silicon back-side processing for image sensors which can be used for high-volume applications.

★ Where do you stand with the production of high-performance silicon retinas?

We manufacture our sensor with a major silicon foundry. If the sensor were to be used in large quantities, almost all of the pieces would be in place for its production in large volumes.

★ What are the next steps for the project, and do you have any follow-up plans after its end?

We are in the last months of the project. The final device has been manufactured and is currently starting to be tested. There are no plans for the current consortium to follow up on this project, but all members will continue working on the technologies developed and the discoveries made over the course of this project.



© SEEBETTER

PROTOTYPE CHIP
DEVELOPED UNDER THE
SEEBETTER PROJECT

SEEBETTER

- ★ Coordinated by Imec in Belgium.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/97441_en.html
- ★ Project website: <http://projects.imec.be/seebetter>

REAL-TIME MALARIA DIAGNOSIS

Improved prevention and control has decreased malaria mortality by 42% globally since 2000. A new device identifies the Plasmodium parasite species and drug-resistant mutations, a major barrier to eradication of the disease.

According to the World Health Organisation, about half of the world's population, numbering in billions, are at risk of contracting malaria. Despite being preventable and treatable, malaria killed approximately 482 000 children under five in 2012, almost one child every minute.

The EU-funded project NANOMAL (Development of a handheld antimalarial drug resistance diagnostic device using nanowire technology) is creating a tool to analyse mutations in malarial DNA with proven nanotechnologies. Treatment can then be based on the malaria parasite while assessing the real-time risk of drug-resistance emergence and the impact of anti-malarial interventions.

The low-cost device capable of delivering a diagnosis within 15 minutes of sampling from a finger prick of blood is being integrated with cell phone technology. The system will support remote consultations, transfer of data to central processing centres for global tracking and appropriate treatment for improved outcomes.

The device works by extracting and amplifying DNA from the sample and binding it to probes immobilised on the surface of nanowire sensors. This assay can thus detect all five species of human malaria including the most dangerous, most common and newest. Furthermore, the assay can also detect more than 10 mutations associated with drug resistance in this dangerous parasite.

All components are now available as working bench-top prototypes that will be miniaturised and integrated into the handheld device and disposable malaria assay cartridge. The consortium has developed a roadmap for commercialisation including links with external advisors to establish regulatory and quality control measures.

Malaria, often seen in the poorest tropical and subtropical areas of the world, can go undetected and untreated due to limited availability of healthcare facilities. The tremendous potential of the NANOMAL device has already been recognised as the number one innovation in malaria elimination by the Guardian Global Development Professionals Network. In the hands of field practitioners, this simple and cost-effective tool will help decrease the morbidity and mortality of citizens around the globe.



© Henrik L. Thinkstock

NANOMAL

- ★ Coordinated by St George's Hospital Medical School in the United Kingdom.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/result/rcn/150945_en.html
- ★ Project website: <http://www.nanomal.org/>

INTERVIEW

NEW DETECTION TECHNOLOGIES FOR BACTERIAL PATHOGENS

In FP7 jargon, RAPTADIAG is categorised as a 'small or medium-scale focused research project'. However, the past two years have seen the consortium turn a novel diagnostic test for bacterial meningitis into what is likely to become a full-blown set of sensor technologies for detecting bacterial pathogens of all kinds.

Whilst the sector has made some giant leaps over the past few years, much contemporary medicine still revolves around symptom-based treatments and costly diagnosis methods. In the case of 'bacterial meningitis' (BM), symptoms would usually develop within three to seven days after initial exposure if at all, as some people can carry the bacteria without getting sick. No treatment means a 50% chance of dying, and the treatment's effectiveness depends on how soon it is administered.

According to Morten A. Geday, coordinator of the RAPTADIAG (Rapid Aptamer based diagnostics for bacterial meningitis)

project and professor, treatment effectiveness is dragged down by the fact that early diagnosis is currently possible only through use of very expensive technologies. Not only are these methods taking too long to give an accurate result, but they are also too complex to be used outside major hospital facilities.

Together with partners from Switzerland and Denmark and thanks to EUR 2.2 million of EU funding, Prof. Geday set out to overcome these obstacles with a fast, easy-to-use and inexpensive diagnostic test for Neisseria meningitidis (aka meningococcus) and Streptococcus pneumonia, which are



© Morten A. Geday

PROF. GEDAY

responsible for 80% of BM cases. He and his team have already developed three groundbreaking technologies, including a microacoustic-resonating sensor and a liquid crystal-based sensor, and are now planning to take their project to the next level.

In this interview, Prof. Geday explains his consortium's journey since the project started in 2011. He also elaborates on the findings that made them reconsider the project's *raison d'être*, from better diagnosis for BM to detection of a much larger spectrum of bacteria, in contexts as varied as food or water borne pathogens entering the food chain, water resources, or even air conditioning units.

★ **What's so new or innovative about this test? How does it work?**

Prof. Geday: The new diagnostic tests will be faster (minutes rather than hours or days) and cheaper (euros rather than several 10s of euros) than the currently-available technologies. They were intended to address the clinical need for a diagnosis of these diseases with a high degree of morbidity, reducing the possibility of misdiagnosis and abuse of antibiotics.

To enable microorganism recognition, we use novel aptamer receptors rather than conventional antibodies. In a nutshell, aptamers are short single-stranded DNA/RNA molecules which can undertake a three-dimensional structure by intra-strand pairing of the nucleic bases. This structure is then selected based on its high affinity and specificity towards the desired antigen or target.

Three different sensor technologies are being developed in parallel. The first technology is the adaptation of the commercial evanescent biosensor technology (Eva-sensor) using aptamer receptors instead of antibodies. Two more experimental (university-developed) technologies are being employed to develop a rapid test at a significantly lower cost, i.e. a microacoustic-resonating sensor and a liquid crystal-based sensor. The challenge in developing these two sensors was first of all to show that it is possible to develop microacoustic-resonating sensors with the necessary sensitivity, and then that we could develop liquid crystal-based sensors with the potential for single cell detection.

★ **What were the main difficulties you faced and how did you resolve them?**

The project has been marred by two problems, one technical and one scientific. Shortly after the kick-off, one of the

principal partners went bankrupt. This meant that the project found itself without the possibility of developing the key receptor molecules, i.e. the aptamers. The solution eventually came from one of the partners who took on this responsibility by employing key staff members from the bankrupted partner. The handling of the bankruptcy, the redefinition of responsibilities, and getting the project back up to speed has led to a six-month delay in execution. However, the highly successful development of both the liquid crystal-based sensor and the microacoustic resonators is closely related to the choices we made then.

The second scientific problem is the development of the BM-specific aptamers. As the project is progressing, it is becoming increasingly clear that the necessary affinity and specificity towards the targets will reach the limits of the consortium's abilities as it stands. To what extent this reflects the limitations of the consortium or the limitations of the aptamer technology is not entirely clear. The workaround is the employment of BM-specific antibodies and existing aptamers targeting alternative pathogens in the testing and validation of the developed technologies.

“Over the longer term (three to five years), we expect the Eva-sensor to become widespread in hospital wards, providing faster and easier detection of a large number of pathogens and other biological targets.”

★ **So you progressively moved away from BM to focus on other types of pathogens. How did that happen?**

During the execution of the project, it has become increasingly clear that while the development of cheaper and faster BM detection could impact the detection and subsequent limitation of a BM epidemic in the Third World, the clinical impact in the West would probably be limited.

At the same time, we have realised that the technologies being developed for BM detection have a significant impact on the detection of bacterial pathogens in a large number of contexts, most notably food or water borne pathogens either in the food chain, in water resources or in air conditioning units. Similarly, these technologies may pave the way for novel means of detection of human pathogens in saliva or other bodily fluids.

As a consequence, various proposals aiming to further mature these technologies were presented in the last round of FP7, and a much more ambitious project — which to some extent is building on the experiences gained during RAPTADIAG — is currently being evaluated in a Horizon 2020 Call.

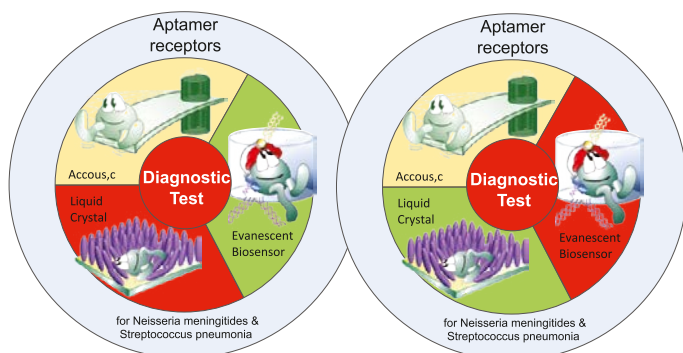
★ **Where do you stand with your objective of delivering at least one commercial product by the end of the project?**

The project is well on track. The Eva-sensor can already be purchased, and Davos Diagnostics have proven that their technology is suitable for bacterial detection using aptamer recognition or otherwise. On the other hand, both the microresonators and the liquid crystal sensors are still too immature. These technologies require a strong industrial partner. In the light of the financial situation in Spain, it is unlikely that funding for a spin-off involving the participating scientists can be found, and thus the technology must be transferred to an existing entity. We will, together

Sensors/Diagnostic kits

Risk:

Price/complexity:



with the technology transfer office at the University, start looking for potential partners in the near future.

★ **Would you say that the project results meet your expectations?**

The project, originally scheduled to finish in June 2015, has already achieved a great number of its objectives. We have proven the use of the aptamers as receptor molecules for bacterial pathogens in the Eva-sensor, resulting in fast and easy pathogen detection (patents pending). At the same time, the microacoustic-resonating biosensor technologies are already approaching the sensibility needed to potentially detect the binding of one microorganism alone, which is the ultimate detection limit, while the liquid crystal sensor is opening the way for an exceedingly simple and inexpensive detection method, with either visual (without the need for any instrumentation!) or simple optoelectronic inspection with miniature readers or even mobile phone

cameras. The microacoustic resonators have already been published in various peer-reviewed journals, while a patent has been submitted in order to protect the liquid crystal sensor technology.

Thus from a technological bio-sensor development point of view, the project has vastly exceeded even the participants' expectations.

★ **When do you think patients and health workers could realistically start benefiting from your findings?**

The payback to society will depend to a large extent on the conservatism of the medical sector. It will be immensely difficult even for our finished product, Eva-sensor, to have a significant impact over the next two years, even though Davos Diagnostics, during — and to some extent, thanks to — this project, has become ISO certified. Over the longer term (three to five years), we expect the Eva-sensor to become widespread in hospital wards, providing faster and easier detection of a large number of pathogens and other biological targets. The future of both the liquid crystal and the micro-resonating sensors will entirely depend on the industrial partners that the consortium gets interested in its technologies.

RAPTADIAG

- ★ Coordinated by the Polytechnic University of Madrid in Spain.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/project/rcn/104082_en.html
- ★ Project website: <http://www.raptadiag.eu>

TOXIC GAS — SENSING AND FILTRATION

Minor gas leaks in work environments pose significant safety risks to public health and the environment. Novel graphene-based filtration membranes can now detect and sequester single molecules of toxic gas.

Scientists working on the EU-funded project GRAPHENEGASSENSORS (Graphene-based ultra-sensitive gas sensors) developed groundbreaking filtration membranes for toxic gases based on the novel material graphene. The membranes are not only capable of sensing a single molecule of gas but they block the molecules from entering the environment.

Since its discovery in 2004, graphene — a one-atom thick sheet of carbon — has become perhaps the most widely used nanomaterial for numerous components and devices. It has unique properties including very high electron mobility in the presence of oxidising and reducing gases providing exciting potential in gas sensing applications.

The team produced graphene-based filtration membranes that first sense ethanol vapour even at parts per

billion concentrations and then block them from entering other media. Scientists have fully developed the process for mass-production of graphene and its derivatives such as graphene oxide as well as the toxic gas filtration membrane. A patent application is in process.

GRAPHENEGASSENSORS delivered a breakthrough in filtration technology with widespread impact on the safety and protection of public health in workplaces and other environments. The outcomes could easily form the basis for new and greatly improved filtration technologies related to organic contaminants and desalination as well.

GRAPHENEGASSENSORS

- ★ Coordinated by the University of Manchester in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150829_en.html





AIR TRAFFIC CONTROL: SAFETY FIRST

Air traffic control (ATC) in Europe urgently needs modernising in order to reduce congestion, but most importantly to boost safety. To fill the gaps of current ATC systems, an EU-funded project developed new technology to identify potential threats and improve the security of citizens against terrorist attacks.



The ARGUS 3D (Air guidance and surveillance 3D) project developed a multi-sensor system able to return detailed, three-dimensional, (3D) maps of the area under surveillance. By analysing information data from multiple sensors, it provides information about the nature of non-cooperative aircraft and the level of threat they present.

The ARGUS 3D system combines the advantages of conventional surveillance systems with those of two non-conventional radar-based systems. It analyses data received from 3D primary surveillance radars to determine the altitude of an aircraft. At the same time, a network of passive radar sensors allows for viewing targets from different perspectives.

The combination improves the accuracy with which an object's position is determined as well as the extent of the area covered, thus reducing the blind areas while increasing safety in sensitive areas. The ARGUS 3D system is expected to provide a significant upgrade to the air traffic picture in critical situations like terrorist activities.

From tests carried out under real-life conditions in the area around Rome, researchers determined the accuracy with which the position of non-cooperative aircraft can be estimated. There is room for improvement, especially through the use of antennas able to more accurately steer the emitted beams. However, in those cases analysed by ARGUS 3D, the altitude was estimated within an accuracy of 300 metres.

By analysing data from ground sensors, instead of solely relying on data transmitted by aircraft, alerts can also be provided in a timely manner. Once an incoming threat is detected, the ARGUS 3D system can assist the operator suggesting the most effective counter-measure in the area under surveillance.

The ARGUS 3D system, with further improvements, could be applied beyond civil ATC challenged

by the steadily growing number of aircraft. The way to controlling battlefield airspace and vessel traffic has been paved, along with monitoring cars in open space. These applications will no doubt be further investigated within future projects.

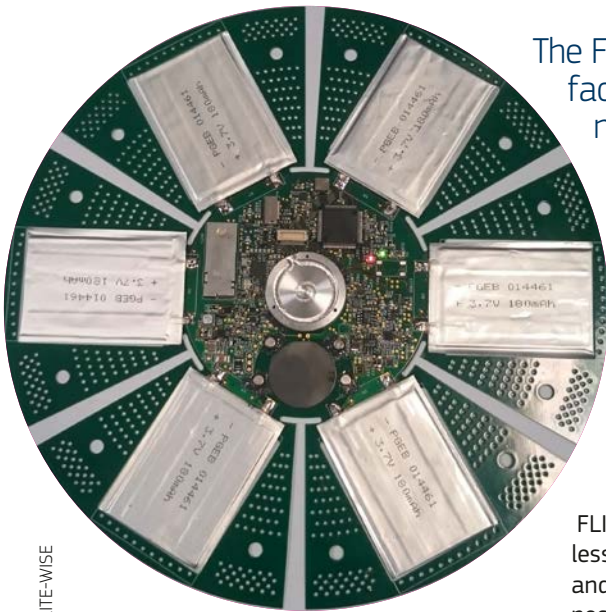
“The ARGUS 3D system is expected to provide a significant upgrade to the air traffic picture in critical situations like terrorist activities.”

ARGUS 3D

- ★ Coordinated by Selex ES SPA in Italy.
- ★ Funded under FP7-SECURITY.
- ★ http://cordis.europa.eu/result/rcn/150618_en.html
- ★ Project website: <http://www.selex-es.com/-/argus-3d>

WIRELESS SENSORS MAKE AIRCRAFT MAINTENANCE MORE EFFICIENT

The FLITE-WISE project has developed new wireless sensors to facilitate the constant monitoring of European aircraft. The new system, which is expected to bring both cost and weight down, will be commercialised within the next three years.



© FLITE-WISE

Some 842 million passengers took a flight in the EU-28 in 2013. With such mind-bending figures, it hardly comes as a surprise that airplane safety is continuously monitored, with rules that keep being reviewed and improved based on the latest technologies and scientific knowledge. In fact, it is safe to say that flying is one of, if not the, safest forms of transport.

However, monitoring the condition of an aircraft is costly and time-consuming. Maintenance typically accounts for 10 to 20% of aircraft-related operating costs, and the use of wired sensors to monitor engines, airframes, structures, gearboxes and other key components of an aircraft is one of these things that contribute to bumping up the bill.

The EU-backed FLITE-WISE (FLite Instrumentation TEst Wireless SEnsor) project was set up with a view to moving away from the unnecessary burden presented by wires, and towards a 'Wireless sensor network' (WSN) relying on smart sensors using a radio interface to communicate with each other. The project, which is part of the Joint Technology Initiatives under Clean Sky (a public-private partnership between the Commission and the Aeronautical industry to reduce the environmental impact of aviation), was completed in December.

Jean-Dominique Decotignie coordinated the project on behalf of CSEM. In this exclusive interview for the

*research*eu magazine*, he explains the technical advances made under FLITE-WISE and expands on its added value for the sector.

★ What were the main objectives of this project?

Jean-Dominique Decotignie:

FLITE-WISE set out to develop a wireless sensor system to which acoustic and pressure sensors may be connected (with openness to other types of sensors), which is able to operate airborne for continuous flight test measurements. This translated into two use cases.

The first is a fully-integrated wireless sensor node dedicated to acoustic measurements along the fuselage of an aircraft. It is a circular, flexible patch designed to be applied to the aircraft skin and consisting of a sensor node packaged such that it can sustain the harsh environmental conditions of test flights. With its maximum thickness of less than 3 mm, it accommodates one acoustic sensor, communication capability, storage and energy for a 12-hour campaign. It is powered by ultra-thin batteries which can be wirelessly recharged by inductive coupling, making it possible to sample frequencies of up to 50 KHz with a maximum time-stamping error between two nodes of below 50 μ s.

The second is the rotating use case, which contributes to the development and testing of a new generation of contra-rotating open rotor engines with an environmental performance significantly higher than that of traditional turboprops. The project remained at the demonstrator stage for this part. The sensor node is fully autonomous in terms of energy, with a specially-developed inductive energy harvester, and capable of acquiring data from eight sensors with synchronisation accuracy, relative to the propeller position, below 0.05°.

★ What are the main constraints posed by current wired sensors?

Wired sensors are currently used for monitoring the condition of aircraft engines, structures, gear boxes, and so on. The design of the sensor placement and its deployment and installation are cumbersome and thus costly. In addition, installing such sensors takes a lot of time, making it a major impediment to temporary installations. Finally, in some cases, for instance in moving parts such as engines, it is very difficult to wire sensors.

★ You claim that wireless sensors will bring down costs. How so?

A wireless sensor network, i.e. smart sensors with radio interfaces, promises unprecedented operational benefits. Lower airplane sensor wiring costs, lower weight (because cabling is highly reduced) and greater flexibility when deploying on airplanes, i.e. without the need to redesign the data wiring layout, are certainly some of the major arguments in favour of programmes such as the Smart Fixed Wing Aircraft under Clean Sky.

★ What is the added value of your technology for the aeronautic industry, this time in terms of effectiveness?

Besides the cost and weight reduction mentioned above, the technology allows us to install sensors almost anywhere on a plane, and thus sense different types of parameters near their source (heat, stress, etc.). This can result in improvements in plane testing and aircraft maintenance.

"A wireless sensor network, i.e. smart sensors with radio interfaces, promises unprecedented operational benefits."



★ **What were the main difficulties you faced during the project and how did you resolve them?**

The main challenges of the project were to produce: energy harvesting and electronics capable of withstanding very high accelerations and extreme (low and high) temperatures; a communication system resilient to radio interferences and jamming, with ultra-low energy consumption; a highly compact and slim design with fully wireless operations including charging for out-of-skin placement; and accurate synchronisation of sensor measurements between different nodes.

This was all achieved through a careful concurrent engineering approach thanks to the multidisciplinary team: Imperial College as a specialist in energy scavenging and storage, SERMA Ingénierie as an aeronautical electronics expert and CSEM for the low-power electronics, wireless protocols and wireless power supply. Energy scavenging required a new design based on magnetic induction. The communication protocol was improved to further reduce consumption by constantly adapting to the aircraft operational phase. Reduced consumption

together with optimised energy storage and highly integrated electronics were key to size reduction. Finally, synchronisation was achieved with very careful component selection and embedded implementation.

★ **When do you expect your technology to be commercialised?**

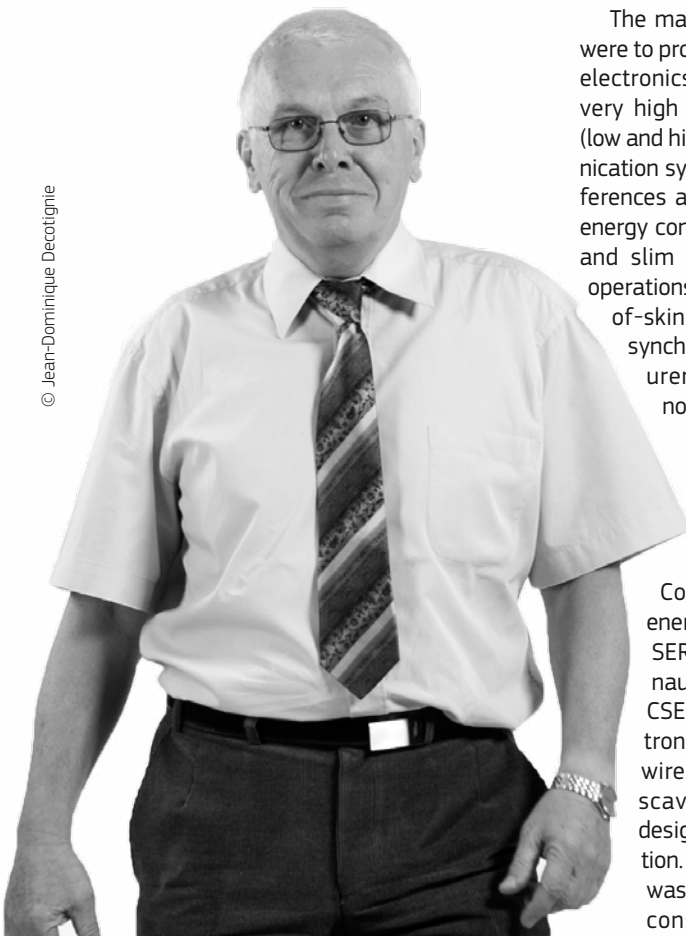
Given the application industry, aeronautics, in which development and certification cycles are between 5 and 10 years long, the technology will be available commercially in 2 or 3 years.

★ **What are the next steps for the project, and do you have any follow-up plans after its end?**

The technology has to pass the flight tests with the help of the topic manager Airbus Operation. This is planned for 2015. The prototypes will then be industrialised, to be manufactured in serial production. The technology will also be further developed for improved performances in terms of sampling rate and bandwidth as well as jamming protection.

FLITE-WISE

- ★ Coordinated by CSEM in Switzerland.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/project/rcn/108855_en.html



© Jean-Dominique Decotignie

JEAN-DOMINIQUE DECOTIGNIE

NEW PANELS FOR AIRCRAFT NOISE REDUCTION

EU-funded scientists have unveiled a novel active control system in a bid to mitigate aircraft cabin noise.

Turbulent airflow over the fuselage surface generates noise that is radiated by vibrating panels. Although absorbing materials are already used on panel surfaces, passive methods are unfortunately not effective against low-frequency noise components.

The EU-funded SPRINT (SPRINT — Smart panels for the reduction of noise transmission) project focused on embedded sensor-actuator pairs evenly distributed on a smart panel surface. These control units generate active damping, significantly decreasing sound transmission at low frequencies.

Project members simulated sound transmission from a smart double-panel system. In addition to force actuators and velocity sensors, a mathematical model was extended to include frequency response from coil actuators and accelerometer sensors.

To achieve maximum performance, the stability of this decentralised velocity feedback control architecture was analysed. As an increase in the feedback loop number does not necessarily lead to performance improvement, project partners sought instead to optimise their number.

An electromechanical test rig was successfully built to test system control effectiveness, stability and noise abatement. Experimental validation on the rig should significantly increase knowledge regarding the effectiveness of the proposed active control method.

Further experimental work is highly likely to result in more publications in peer-reviewed journals. The final outcomes are expected to lead to a successful demonstration of a very interesting and novel active noise control technique.

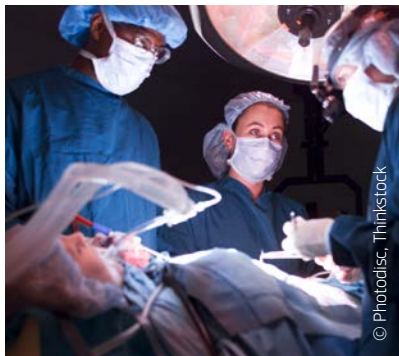
“Project members simulated sound transmission from a smart double-panel system.”

SPRINT

- ★ Coordinated by the University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Croatia.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150871_en.html

BIOCOMPATIBLE MOLECULAR SENSORS

Measuring critical blood biochemical parameters continuously at a patient's bedside is a very important part of healthcare. EU researchers have developed reliable molecular sensors to achieve this ambitious goal.



Efficient biochemical sensors for blood components such as sodium have to be biocompatible and reliable. The development faces issues with power consumption and liquid handling over extended periods of time as the sensor micro-channels are prone to blockage.

The aim of the EU-funded RECEPTOR-DOPED GELS (Receptor-doped Ionogels: New materials for inherently

biocompatible molecular sensors) proposal was to develop an improved biocompatible molecular sensor. Furthermore, researchers aimed to develop sensors for incorporation into so-called 'lab on a disc' to improve healthcare test devices.

An 'ionogel' (IL) is a new material where an ionic conducting liquid is immobilised inside a polymer matrix. Researchers synthesised hybrid materials consisting of monomeric components polymerised within biocompatible IL. This resulted in various platforms for modification. Doping of the IL hybrid material with a selective ionophore enables ion selectivity. Detection of lactate, for example, using a specific sensor with an IL solid-state electrolyte is feasible.

The IL sensors were integrated into a 'lab on a disc' microfluidic technology that provided proof of principle for rapid and multiple analysis *in situ*. A fully

functional prototype of the analyser has been developed with a view to commercialisation.

RECEPTOR-DOPED GELS addressed the problems in bio-compatible sensor design using the novel biocompatible material. Selectivity of IL sensors can be varied for target ions in the body such as sodium, potassium and calcium. Sensors of this nature are important in monitoring patients with cancer and diabetes, and those recovering from heart surgery. The same simple and low-cost technology could be applied for water contamination tests in order to obtain quick and easy *in situ* detection results.

RECEPTOR-DOPED GELS

- ★ Coordinated by Dublin City University in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150526_en.html

INTERVIEW

NEW SENSORS CAN FIND A BOMB BEFORE IT'S EVEN READY TO BLOW UP

Improvised explosive devices are one of the biggest threats to security in Europe. But what if we could detect those devices, even before they are ready to detonate? The BONAS project hopes to make this possible with a range of early detection devices relying on chemical sensors.

Although Europe is generally considered as a safe place to live, isolated attacks over the last decade have put terrorism high on the EU agenda for security. The 2005 London bombings, the car explosion in Oslo in 2011 and the Al Qaida attacks on Madrid's train line in 2004 speak for themselves: terrorists armed with improvised explosive devices can strike at any moment. And new technologies are needed to find these devices before they put the lives of EU citizens at risk.

The EU-funded BONAS (BOmb factory detection by Networks of Advanced Sensors) project holds much promise when it comes to developing these novel, early detection technologies. With 12 partners specialising in research, sensor development, nanotechnology, wireless technologies and field deployment, the consortium aims to develop state-of-the-art sensors to detect the chemical traces left by hidden explosive devices — be it in the air or in water. But the true innovation lies in how far upstream they can do their job. According to project coordinator Antonio Palucci from the Italian National Agency for New Technologies (ENEA), the sensors can detect explosive precursors even before they are turned into an artisanal bomb.

In this exclusive interview with the *research*eu results magazine*, Palucci expands on the project's objectives, how close he and his

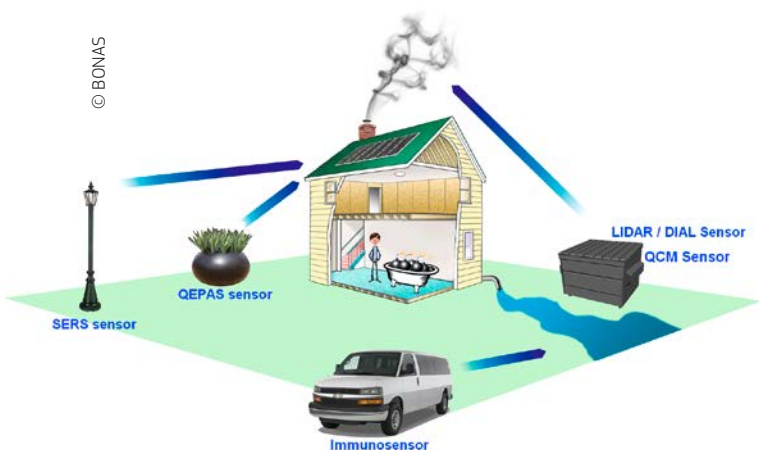


ANTONIO PALUCCI

team are to achieving them and the odds of these new technologies being used by national security agencies across Europe.

★ What is the main objective of the project?

The security of EU citizens is one of society's main concerns. This is a result of unexpected terrorist attacks or criminal events which have led to explosions and left people deeply shocked, such as what happened in Norway in 2011.



© BONAS

The EC has taken various measures to counteract and prevent these events with social and technological instruments. It is now much more difficult and time-consuming to collect, assemble and set up a final 'improvised explosive device' (IED) when planning a terrorist and/or criminal act.

The BONAS project is taking these instruments a step further. We have been developing new sensors for the detection not only of hidden explosive compounds but also of the precursors needed for their preparation. All these sensors are connected through a wireless network, which makes their management easier and more effective. Furthermore, we have come up with a strategy to be implemented on site in order to support intelligence services in discovering suspected illegal activities.

★ **How does your technology compare to existing detection systems? What's most innovative about it?**

We have implemented five technologies to address precursor detection in different states: liquid, particle and vapour. Presently, there are no specific sensors available for precursor detection, so our technological solutions have been created for this very purpose. In particular, some technologies such as lidar (laser stand-off detection of vapour emissions) and QEPAS (*in situ* quantum cascade laser detection of vapour emissions) have been tailored to detect specific molecules emitted in the preparation phase.

We have upgraded electrochemical sensors to include multi-electrodes for the detection of anomalous substances released in sewage waters. We also matched a handheld Raman sensor with a particle sampler which is itself equipped with a nanostructured enhanced metal surface in order to increase detection capability. Concretely, this technique is using laser technology to identify the chemical fingerprint of explosives in scattered particles and could eventually send a warning when the concentrations reach a certain threshold.

★ **What is a typical situation where the wireless sensors could be used?**

The foreseen strategy for distributing the wireless sensors includes using the sewage piping network, for extensive coverage of a district. Alongside stand-off detection (which takes place at greater distances from people and vital assets in order to reduce the risk of severe damage), the sensors can be deployed *in situ*. All sensors could be camouflaged and deployed around the suspicious item.

★ **What were the main difficulties you faced during the project and how did you resolve them?**

The main difficulty was to match the sampler to the sensors. The mechanical and technical solutions were agreed with partners after different tests.

★ **Where do you stand with the feasibility study? Does the technology meet your initial expectations?**

The feasibility study was completed and I am proud to say that we successfully met the initial requirements.

★ **The project is getting close to its end. Do you think mass production is realistic?**

The network of sensors has already been tested in two field campaigns. The first in June 2014 at the Pratica di Mare (Rome — Italy) Military Airport and in September at the FOI (Swedish Defence Research Agency) facility near Stockholm, jointly with the EMPHASYS project.

Of course, due to the specific nature of the application (precursor detection, remembering that the list is classified), real mass production is not realistic for all the sensors. But the handheld Raman spectrometer has recently been introduced to the market by our SME partner.

★ **Is your project generating interest from governments, be it in Europe or overseas?**

Different Italian forensic investigation agencies (Polizia Scientifica, Carabinieri and Aviation Army) have already expressed their strong interest. The FOI is also very enthusiastic about our solutions.

BONAS

- ★ Coordinated by ENEA in Italy.
- ★ Funded under FP7-SECURITY.
- ★ http://cordis.europa.eu/project/rcn/98486_en.html
- ★ Project website: <http://bonas.tekever.com/>

TOWARDS MEDICAL IMPLANTS POWERED BY ENVIRONMENTAL SOUND WAVES

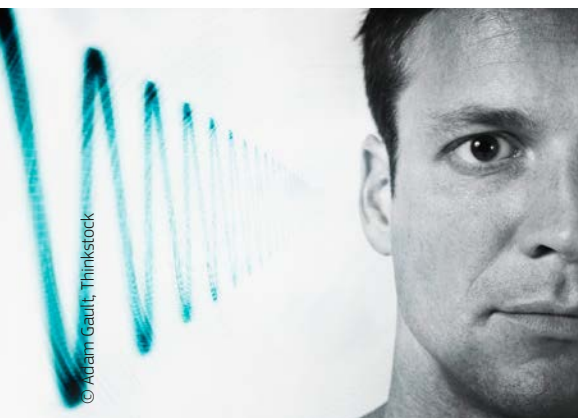
The minuscule devices made possible by advances in micro- and nanotechnology have similarly small power requirements. EU-funded scientists laid the groundwork to integrate energy harvesting for autonomous power.

Energy-harvesting technologies use minimal amounts of energy from the environment to produce electricity that can power practical devices. For instance, portable or even implantable devices such as pacemakers could be powered by human motion.

An especially interesting approach to energy harvesting takes advantage of 'piezoelectric' materials which can transform mechanical energy into electrical energy, as discovered in 1880 by the French brothers Jacques and Pierre Curie. Very recently, it has been suggested that piezoelectric nanomaterials can be even

more advantageous because of their outstanding mechanical properties, higher piezoelectric coefficients, and compatibility with flexible and wearable substrates.

However, despite very promising preliminary results, for practical applications, piezoelectric nanogenerators require



improvements in both manufacturing processes and efficiency of transduction.

The EU-funded project PING (Piezoelectric nanogenerators on suspended microstructures for energy harvesting) addressed these issues with major advances in a very short time.

In particular, the researchers sought to improve a low-temperature production process (aqueous chemical growth) in order to substantially increase both the homogeneity and the length of zinc oxide nanowires. They also proposed to further enhance the potential for electricity generation by integrating long nanowires with

suspended miniature bridges and diaphragms in order to transform the incoming acoustic energy into even greater deflection of the nanowires.

Localised heating during the growth process was adopted to facilitate longer nanowires of more uniform structure. The team designed innovative micro-heater concepts using finite element method models and, as preliminary results, scientists have already produced very long zinc oxide nanowires using heating of the substrate only rather than the entire nutrient solution. This resulted in substantial decreases in material waste and energy consumption. Advanced microscopy techniques were employed to evaluate the morphology and crystallinity of the nanowires.

The technique is not only promising for fabricating high-performance devices but also cost effective and environmentally friendly. The substrate heating method is currently being further developed and the first packaged devices are being characterised.

PING has laid the groundwork for developing substantially improved piezoelectric nanogenerators and nanodevices thanks

“Very recently, it has been suggested that piezoelectric nanomaterials can be even more advantageous because of their outstanding mechanical properties, higher piezoelectric coefficients, and compatibility with flexible and wearable substrates.”

to novel processing methods. The nanogenerators should prove suitable in numerous applications such as implantable medical devices and wireless sensor networks. Autonomous power eliminating the need for rechargeable batteries will enable the devices to work as long as materials hold out.

PING

- ★ Coordinated by Università Degli Studi di Roma tor Vergata in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150851_en.html

UTILISING NOVEL MEASURES TO ENHANCE PRODUCT QUALITY

Despite growing competition from emerging industrialised nations, European polymer processing still relies largely on trial and error. Thanks to in-line sensors developed with EU support, that era is going the way of the dinosaur.

Europe is the second largest plastics manufacturer globally and the worldwide leader in plastics recycling. However, lack of direct measurement technologies for processing parameters and conditions leads to reduced reliability of final product characteristics and large volumes of scrap.

Two new ultrasonic sensors to measure density and viscosity inside extruders in real time herald a step-change in European plastics processing. With EU support of the project POLYSENSE (Development of a low cost in-line polymer inspection system to improve the use of recycled materials in plastics processing industry), scientists have significantly improved process technology to reduce scrap produced from raw materials and enable greater utilisation of scrap to produce new products of higher quality.

The density sensor has been tested in an industrial environment for processing both virgin and recycled polypropylene. It withstands processing temperatures and pressures, and demonstrates good

resolution and repeatability of measurements. In addition, with proper calibration, it shows promising potential for use in sensing the percentage of filler in a material.

Scientists tested the ultrasonic viscosity sensor in laboratory operation of extruders on several polymers and calibration liquids. The sensor was able to measure viscosity at high temperatures and provide a measurement each second despite the required electronic signal processing being done by a computer. Accurate viscosity measurements will facilitate increased processing speeds for higher throughput without stoppages to deal with clogging.

POLYSENSE ultrasonic density and viscosity sensors for in-line measurements of polymer processing characteristics should facilitate enhanced product quality and reliability, faster throughput and reduced scrap. These benefits are equally applicable to virgin and recycled polymer processing and promise to significantly boost the competitive edge of numerous European small

“POLYSENSE ultrasonic density and viscosity sensors for in-line measurements of polymer processing characteristics should facilitate enhanced product quality and reliability, faster throughput and reduced scrap.”

and medium-sized enterprises active in the plastics industry. Eco-conscious consumers will also be happy to see an increase in the quality of plastic products together with reduced scrap volume.

POLYSENSE

- ★ Coordinated by Ibanez Extrusoras, S.L. in Spain.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/150827_en.html
- ★ Project website: <http://www.polysense.eu>

BIOLOGY AND MEDICINE

MAGAZINE EXCLUSIVE

RUNSAFER: WHEN SPORT SHOES START CARING FOR YOU

Sometimes the limits of the mind are beyond that of the body, which in the context of intensive sport practice can often lead to unanticipated injuries. Other than having a trainer following your every step, this problem seems inexorable. But a smart running shoe could soon help mitigate that risk, ultimately becoming a runner's best friend.

If anything, 2014 was the year of smart wearables and tech-supported healthy lifestyles. From heart beat and step sensors synced with health apps to omniscient wristbands, high-tech companies are full of ideas and this emerging market is likely to become a major playfield over the years to come. Smart watches, headsets, glasses and clothes are set to hit the market in 2015. And thanks to the RUNSAFER (Development of a running shoe with embedded electronics providing real time biomechanical feedback to reduce injury risk and enhance motivation, and a web portal allowing real training management) project, even smart running shoes are just around the corner.

At this point, you might be wondering what a smart running shoe could bring to the table that other

wearables do not already offer. According to the project description, this added value resides in the device's capability to detect fatigue and help prevent injuries, analyse runners' performance and provide personalised suggestions to improve their running pattern.

'The RUNSAFER system comprises a running shoe fitted with a micro-electronic measuring system,' explains Nicolás Palomares, technical coordinator and researcher at the Biomechanics Institute of Valencia. 'This system is capable of recording the biomechanical parameters which characterise the runner's technique. It also records physiological parameters thanks to a heart rate monitor.'

Since shoes don't speak (yet?), all this information is then transferred wirelessly, in real time, to the

runner's smartphone for analysis. There, in addition to information already supplied by other commercial devices such as speed, exercise time, distance covered, GPS monitoring, calories consumed and running speed, runners can find precious advice on how to adjust their training.

The ultimate running experience

Suppose that you have been running for quite some time. Exhaustion might modify the biomechanical and physiological parameters monitored by the RUNSAFER shoes, in turn affecting the way you run. As soon as the system judges this change excessive — to the point where injury becomes a likely scenario — RUNSAFER will notify you via the dedicated app, offering a series of recommendations such as reducing speed or simply terminating the training session.

'At the same time, the athlete may also download all the information generated from a website, which has a specialist app for planning training sessions. This online applica-

"The application offers recommendations for adjusting the training plan, with the aim of improving the runner's performance and preventing injuries."

tion offers different training plans, depending on the runner's level. Based on the biomechanical analysis of the running action, the application offers recommendations for adjusting the

training plan, with the aim of improving the runner's performance and preventing injuries,' says Palomares. And just like any self-respecting Web 2.0 application, this website also includes features characteristic of online social networks, enabling runners to keep in touch with their counterparts all over the world and to share content such as running routes and information on the most suitable footwear.

The 'magic' shoes have already been tested on volunteers from various runner associations and clubs, and generated great interest among runners across the world, according to Palomares. 'With over 80 million runners in Europe, it is no surprise that wearable measurement systems are


becoming more and more common in the training practice of athletes and recreational runners. While many parameters can be measured in the lab, on the track or on the road, commercial technology is currently limited to the measurement of specific parameters such as heart rate, GPS position, speed and distance. However, none of these commercial solutions are suitable for measuring running technique parameters,' he adds.

Commercial plans

All in all, the project successfully developed the system's wireless transmission system, along with a shoe with optimum biomechanical properties, a custom-made microelectronic chip embedded in the shoe, an app, a web portal and a functional prototype. Now that RUNSAFER has come to an end, commercialisation would be the logical next step. And although this is certainly not an easy task in a market dominated by a handful of international brands, the disruptive nature of this technology makes it difficult to ignore.

'This project has effectively aroused great interest from a particular shoe brand. New Millennium Sports S.L. (commercially known as KELME), a major Spanish manufacturer and distributor of sportswear, footwear and equipment for sports, has actively participated in the RUNSAFER project. KELME is currently studying the commercialisation plan for the brand new running shoe, which is expected to hit the market soon if the conclusions of their technical and economic feasibility studies are positive.

RUNSAFER

- ★ Coordinated by the Biomechanics Institute of Valencia in Spain.
 - ★ Funded under FP7-SME.
 - ★ http://cordis.europa.eu/project/rcn/104952_en.html
 - ★ Project website: <http://www.runsafer.eu/>
 - ★  <http://bit.ly/1x03itX>
-

EU PROJECT DESIGNS HOME CARE SYSTEM FOR LIVER PATIENTS

A European ICT for Health project aims to improve the quality of life of patients with chronic liver disease, by developing a remote support system to monitor their condition at home.

Some 29 million Europeans suffer from chronic liver disease. It is one of the most common causes of death in the EU and doctors believe that tens of thousands of early deaths could be avoided with the right health-care once the condition is diagnosed.

The EU-funded project D-LIVER (ICT-enabled, cellular artificial liver system incorporating personalized patient management and support) aims to help patients with advanced liver disease, many on long waiting lists for

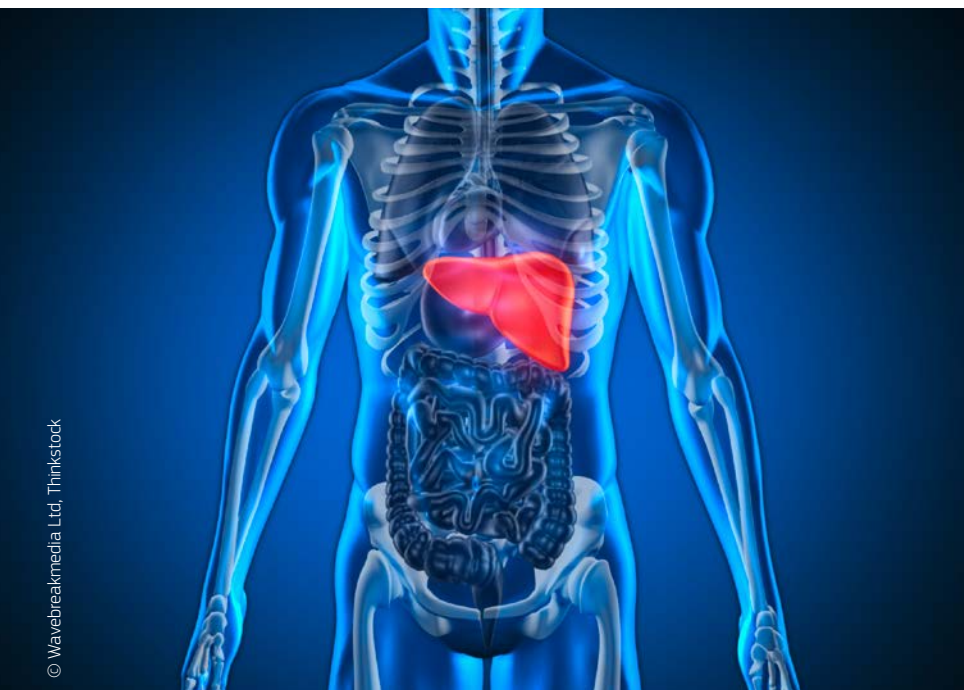
transplants, by saving them painstaking regular trips to hospital for tests and appointments with consultants. It is developing an ICT-enabled remote support system for the patients to use in their homes. The D-LIVER system will allow them to test for a variety of biochemical and physical parameters fundamental to understanding their well-being and needs in real time.

'As my liver condition deteriorated, my ability to walk around diminished dramatically,' revealed Martin Owen, a

commercial airline pilot who managed to return to work after a transplant. 'I used to spend my life asleep in a chair at home because I had absolutely no energy at all. I had to rely on my wife to take time off her employment to take me into hospital,' he said in a film about the D-LIVER project.

Live longer, live better

A typical patient, Martin still has to visit the hospital every six weeks, first for a blood sample, then a few days



© Wavebreakmedia Ltd, Thinkstock

D-LIVER technology could be applied to other diseases

As D-LIVER coordinator Prof. Calum McNeil, of Newcastle University, explained: 'The platform is generic. Once we get over the technological hurdles, it could be applied to all sorts of other disease conditions: e.g. management of cardiovascular, renal, neurological and inflammatory diseases.'

Colleagues of Prof. McNeil at Newcastle University, studying the economics of such a system, estimate it will save thousands of euro a year in hospital admission costs per patient, particularly those with hepatic encephalopathy.

Now the technology developed during the first two years of the project is to be tested on patients. Between now and the end of D-LIVER in September 2015, participants are preparing for a multi-centre clinical trial of the system they plan to conduct in 2016, involving up to 150 patients in Newcastle, Berlin and Milan.

D-LIVER, which ends in September 2015, involves 14 partners from seven countries and is receiving just under EUR 11 million in funding from FP7-ICT for Health.

later for the consultation to discuss the results. 'Active involvement in my own care would be a boon to me,' he says.

One of the aims of D-LIVER is to hand back control to the patient. By developing the home monitoring and support system, connected to a central liver patient management system at the hospital, the project focuses on improving quality of life for patients at an advanced stage of the disease. Such patients might be waiting for a transplant; they may have undergone liver resection, where the remaining organ is undergoing regeneration; or they may have unstable advanced disease, prone to episodes of deterioration.


Using the system developed by D-LIVER, the patient inserts a 3 cm x 3 cm plastic chip into a measurement instrument and then simply has to prick a finger and squeeze a drop of blood which,

when presented to the cartridge opening, will be immediately drawn into the system. The test results are carried out automatically and the results of the various parameters (sodium, potassium, creatinine, bilirubin, albumin and blood clotting time) become available within a few minutes.

D-LIVER has also created a wearable device to allow continuous monitoring of physiological parameters such as heart rate, temperature, activity, posture and changes in blood pressure. And it has a cognitive test on a tablet computer to measure concentration and brain function, since high liver toxicity often leads to a state of mental confusion (encephalopathy).

These tests can be performed as often as required, daily or weekly, and the results are available not just to the patient at home, but also to the clinician monitoring the patient from the hospital.

D-LIVER

- ★ Coordinated by the University of Newcastle upon Tyne in the United Kingdom.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/result/rcn/150356_en.html
- ★ Project website: <http://www.d-liver.eu/>
- ★  <http://bit.ly/14rC0gb>

ELUCIDATING NEURAL TUBE PATTERNING

EU-funded scientists have investigated the mechanisms involved in neural tube patterning, a key process required for the development of the spinal cord. Applications include tissue engineering and regenerative medicine as well as stem cell research.

The EU-funded project NEURAL TUBE NETWORK (Systematic analysis and modeling of the gene regulatory network underlying neural tube patterning) was initiated to elucidate the 'Gene regulatory network' (GRN) involved in neural tube patterning. The researchers used the chick embryo for transcriptional profiling.

Neural tube patterning involves the expression of different types of 'transcription factors' (TFs) and signalling molecules such as 'sonic hedgehog' (Shh) to produce functionally-distinct neuronal subtypes. The Shh-controlled GRN is a major player in

controlling this process and determines the fate of these neuronal subtypes.

Scientists performed 'High throughput mRNA sequencing' (HTS) on chick neural tube cells for transcriptome analyses at different time-points of Shh signalling. Differentially expressed genes were successfully identified and results were validated using data from Nanostring nCounter, a fully automated system used to profile RNA and DNA.

A chick TF database was generated and used to annotate the transcriptome data obtained previously. The researchers then

“Results revealed that a combination of specific TFs needs to be expressed to generate distinct neuronal progenitor domains during neural tube patterning.”

distinct neuronal progenitor domains (e.g. p3 and pMN) during neural tube patterning. These p3 and pMN domains are spatially distinct in the ventral spinal cord where the p3 domain produces V3 interneurons and pMN generates somatic motoneurons.

In parallel, work is ongoing to develop computational approaches to model the Shh-controlled GRN to represent gene regulation by TFs during ventral neural tube patterning.

compared the profiles of differentially expressed TFs from altered Shh signalling at different periods.

Results revealed that a combination of specific TFs needs to be expressed to generate

Project outcomes have revealed that neural tube TFs act alone or in combination to produce different progenitor gene expression profiles in response to Shh concentration.

Validation of these findings will have important implications with regard to understanding the dynamics of gene regulation and its role in spinal cord development. Study results could also be extrapolated to other developing tissues and used to develop innovative medical interventions through stem cell therapy or artificial bone or skin grafts.

NEURAL TUBE NETWORK

- ★ Coordinated by the Medical Research Council in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150912_en.html

STUDY REVEALS NEW INFORMATION ON GENETIC ARCHITECTURE OF KIDNEY CANCER

A new study, conducted under the EU-funded project CAGEKID (Cancer genomics of the kidney), has revealed a link between ‘Renal cell carcinoma’ (RCC) and exposure to aristolochic acid.

The study, which involved a large group of kidney cancer patients in Europe, reveals new information on the genetic architecture of the disease. It also shows an apparent link between exposure to aristolochic acid and incidence of kidney cancer, particularly in Romania.

RCC is a serious public health problem within Europe, where the highest global incidence of the disease is found. The number of RCC cases has been increasing over the last two decades, and it is now the eighth most common cancer in Europe. This study reveals that there is a link between this type of cancer and aristolochic acid, a compound found in plants of the *Aristolochia* genus. One of these plants, *Aristolochia clematitis*, commonly occurs throughout the Balkans.

Led by scientists from the McGill University and Genome Quebec Innovation Centre in Montreal, the study involved whole-genome sequencing on DNA isolated from blood and tumour tissue samples and RNA sequencing on tumours and matched normal tissue samples taken from a total of 94 kidney-cancer patients in four countries: the Czech Republic, Romania, Russia and the United Kingdom.

Yasser Riazalhosseini, an assistant professor of genetics at McGill, notes, ‘The most striking observation was the

high frequency of a specific type of mutation pattern found in the Romanian patients. The specific sequence context surrounding these mutations and their predominance on the non-transcribed strand of DNA enabled us to hypothesise that the mutation is due to exposure to aristolochic acid during the patient’s lifetime.’

Professor Mark Lathrop, scientific director of the McGill University and Genome Quebec Innovation Centre, adds, ‘While the study included only 14 patients from Romania, the specific mutation pattern was found in 12 of them. As a result, we will analyse samples from more patients from Romania and elsewhere in the Balkan region, in follow-up research that is now underway to assess the extent of exposure.’

The study was carried out under the CAGEKID project, a part of the International Cancer Genome Consortium (ICGC). Coordinated by the Jean Dausset Foundation CEPH in France, CAGEKID concluded in August 2014 after over three years of research. The CAGEKID project team succeeded in identifying potential biomarkers for RCC from complete genome mapping of 45 samples. Biomarkers like this could be used for early diagnosis and to provide targeted therapy. Ultimately, this could improve the prognosis for affected



patients and give valuable insights into the variability in RCC incidence across Europe and globally.

CAGEKID

- ★ Coordinated by the Fondation Jean Dausset centre d'étude du polymorphisme humain in France.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/news/rcn/122052_en.html
- ★ Project website: <http://www.cng.fr/cagekid/index.html>

MECHANISMS OF MALIGNANT SKIN CANCERS

Malignant skin cancers, melanomas, are difficult to detect and treat and rapid disease progression results in poor patient outcomes. There is a need to understand the malignancy process at the molecular level to develop appropriate and personalised diagnostic and therapeutic approaches.

Five European academic institutions and two ‘Small and medium-sized enterprises’ (SMEs) with expertise in melanoma biology and state-of-the-art technologies collaborated with EU funding. The project TARGET-MELANOMA (Molecular dissection of melanoma progression: An integrated Pan-European approach) worked on discovering novel biomarkers to better determine the outcome of patients with melanoma and to identify innovative treatment options.

The scientists studied melanoma tissue cohorts and pre-existing omic-level data for melanoma biomarker selection and validation. Cutting-edge techniques such as Illumina arrays, tissue microarrays, pyrosequencing and *in silico* analysis detected melanoma-associated genetic and epigenetic alterations. The most promising targets were then functionally validated with an *in vitro* assay that models a key metastatic process.

In Irish melanoma patient groups, high-throughput genotyping revealed previously unknown mutation rates in genes associated with melanoma. Successful validation of these findings could help personalise treatment for such melanoma patient groups and improve treatment efficacy.

Project activities have fostered an industry-academic partnership that has in turn provided valuable cross-disciplinary training for researchers. As a result, 13 recruitment and secondment assignments were carried out over the course of the project.



TARGET-MELANOMA has gained novel insight into the onset and metastasis of melanoma, with several targets for treatment successfully identified. This has laid the foundation for more in-depth studies on this disease and will promote further industry-academia collaboration. Novel discoveries could therefore be rapidly commercialised to benefit the participating SMEs and improve melanoma patient outcomes.

TARGET-MELANOMA

- ★ Coordinated by University College Dublin, National University of Ireland in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150921_en.html
- ★ Project website: http://www.oncomark.com/go/projects/target_melanoma

EBOLA FORECASTING USES MODEL DEVELOPED BY EU PROJECT

Forecasters predicting the spread of Ebola are using one of the most sophisticated modelling systems in the world — the result of an EU research project.

An EU-designed forecasting model has shown that Ebola will have infected between 14 000 and 22 000 people (number of reported cases) in West Africa by the end of November 2014. The Global Epidemic and Mobility Model (GLEaM) is one of the most detailed and inclusive in the world. It was developed by the EU-funded EPIWORK (Developing the framework for an Epidemic Forecast Infrastructure) research project, which ended in 2013.

GLEaM produces realistic simulations of the global spread of infectious diseases by combining real-world data on populations and human mobility with elaborate stochastic models of disease transmission. GLEaM draws

on flows of data never before included in health-related forecasting, such as daily airline passenger traffic, censuses, hospital admissions and medical services, funeral attendances, and even information submitted from mobile phones.

This product of EU research excellence is now available for laboratories around the world to help predict the spread of global diseases such as Ebola.

The use of GLEaM in EBOLA

Professor Vespignani, EPIWORK project leader at the time, is now head of the Laboratory for the Modeling of Biological Socio-Technical Systems (MOBS LAB) at Northeastern University in Boston, USA. ‘We began using the

model for Ebola in July this year, when the disease started to show exponential growth in West Africa. We are also looking at the possibility of Ebola spreading worldwide. In the case of

“The Global Epidemic and Mobility Model produces realistic simulations of the global spread of infectious diseases by combining real-world data on populations and human mobility with elaborate stochastic models of disease transmission.”



Ebola, so far the predictions of reported cases have been accurate within the probability range the model calculates,' he said.

The model was developed during the EPIWORK project, which involved collecting epidemiological data during the 2009 outbreak of H1N1 influenza, commonly known as 'swine flu', and making it available to the research community across the EU.

Daniela Paolotti, an epidemiologist at Italy's Institute for Scientific Interchange (ISI) Foundation, the institution which coordinated EPIWORK, added: 'The focus for GLEaM in 2009 was the H1N1 influenza pandemic, but it was always meant to be extended to other infectious diseases. The idea was to build a framework that could be used for new emerging diseases, and as a result it has been able to be adapted to Ebola too.'

These simulations help policymakers to visualise how the outbreak might spread, and therefore to prioritise public health measures to contain it.

Participatory science via website and app

During the EPIWORK project, researchers also developed 'Influenzanet', a system for monitoring the activity of 'Influenza-like-illness' (ILI). This system has a 'citizen science' focus, obtaining its data directly from people who have completed an online application form containing various medical, geographic and behavioural questions.

Today, Influenzanet has around 20 000 participating volunteers in local communities across 10 EU countries. It provides additional information for epidemiologists and public health scientists, who in the past could only rely on the traditional system of

primary care doctors forming sentinel networks to report the presence of disease. This results in an additional fast and flexible monitoring system, which does not replace the doctors' sentinel network, but allows for direct comparison of ILI between countries.

In many countries involved in Influenzanet, the web data is published weekly on government surveillance websites as an annex to the official data. During the project, the EPIWORK partners developed close contact with national health institutes which they can alert if the data being gathered through Influenzanet warrants urgent attention.

Influenzanet has also produced a reporting app for mobile devices, available through some of the national partners (e.g. <https://www.influweb.it/app/>), iTunes, Facebook and Twitter. 'In countries like Italy, where access to the internet is mostly through smartphones, participation has increased a lot thanks to the mobile app,' observed Daniela Paolotti.

EPIWORK ran from 1 February 2009 to 31 July 2013 and involved 12 teams in eight countries. It received EUR 4.85 million from the 7th Framework Programme.

EPIWORK

- ★ Coordinated by Fondazione Istituto per l'Interscambio Scientifico (I.S.I.) in Italy.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/result/rcn/150997_en.html
- ★ Project website: <http://www.epiwork.eu/>

BRAIN IRON LEVELS IN ADHD PATIENTS

People with 'Attention deficit hyperactivity disorder' (ADHD) often have low intelligence leading to low self-esteem and poor relationships with family and peers. Despite several studies on ADHD, it is still not fully understood due to wide variation in risk factors between patients.

ADHD is a behavioural disorder manifested in childhood with symptoms that may persist in adulthood. As the name implies, individuals with ADHD struggle to pay attention to activities and have poor impulse control and hyperactivity. They also tend to perform poorly in academic and professional pursuits and are more likely to engage in criminal behaviour than individuals without ADHD.

The EU-funded project BRAIN IRON IN ADHD (Brain iron levels in children with attention-deficit/hyperactivity disorder: an imaging and neurophysiological study) was initiated to understand if brain iron deficiency plays a role in ADHD. Scientists assessed brain iron levels along with serum ferritin levels for greater accuracy, as ferritin values (a measure of iron quantity in the blood) do not fully reflect brain iron levels, which are supposed to be involved in ADHD. To measure brain iron levels, a novel neuroimaging technique ('multiple field correlation') was employed.

"Scientists assessed brain iron levels along with serum ferritin levels for greater accuracy."

Project members carried out studies on children at two institutes — one in the United States and one in Italy. Serum ferritin and brain iron levels were measured in children with and without ADHD.

In the US study, it was found that children with ADHD had significantly lower brain iron levels than children without ADHD.

The Italian study investigated the possible consequences of brain iron deficiency. More specifically, it focused on the association of brain iron levels with brain functioning and sleep quality/quantity, using magnetic resonance imaging, electroencephalograms, somatosensory evoked potentials and polysomnography. Significant correlation was found between brain iron levels and the number of periodic movements in sleep. This suggests that low brain iron levels can disrupt sleep, which, in turn, contributes to cognitive deficits and further aggravates ADHD symptoms.

Of note, no differences were found in serum ferritin levels in children with and without ADHD in both studies.

ADHD affects around 5% of children globally and study results suggest that about 15% of such children have brain iron deficiency. Alleviation of ADHD symptoms through early iron supplementation has the potential to benefit this subset of children and vastly improve their quality of life. The effects of iron supplements during pregnancy or infancy to prevent ADHD will need to be investigated in future studies.

BRAIN IRON IN ADHD

- ★ Coordinated by Università Degli Studi di Verona in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150898_en.html

DEPTH PERCEPTION IN HUMANS

Depth perception helps us drink coffee with no spills and dodge aberrant frisbees. EU-funded scientists shed light on the neural mechanisms of depth processing with implications for brain injury rehabilitation and improved robots.

Our ability to discern depth and three-dimensional shapes is largely related to binocular disparity. This disparity is critical to grasping, reaching and manipulating objects which in turn is fundamental to tasks such as driving, sports or eating.

“Scientists measured the subjects’ behavioural performance in perceiving simple objects as well as their fMRI brain activity while making depth judgments.”

Previous studies dedicated to enhanced understanding of the processing of binocular cues have relied on limited data from a small number of brain areas, and used highly-trained subjects and animals. The EU-funded project COMPLEX3D (Neural substrates of depth perception: from surfaces to complex 3D forms) sought to provide a global analysis of the contributions of dorsal and ventral regions of the brain in processing different types of depth information. The project also investigated whether the neural networks involved in depth perception demonstrate plasticity when the behavioural relevance of depth cues is modified through training (learning). Plasticity is the reorganisation of neural networks in response to repeated training.

Researchers used ‘Functional magnetic resonance imaging’ (fMRI) and repetitive transcranial magnetic stimulation techniques to identify brain regions involved in perception of specific shapes and surfaces.

Scientists measured the subjects’ behavioural performance in perceiving simple objects as well as their fMRI brain activity while making depth judgments. The stimuli had either coarse (signal-in-noise) or fine depth information. To determine learning effects on plasticity, the team increased the behavioural relevance of depth stimuli through training paradigms. They applied repetitive transcranial magnetic stimulation to brain regions involved in depth perception

during depth judgments to elucidate potential differences in perception.

COMPLEX3D results supported a role for training in enhancement of noise filtering mechanisms that can lead to improved depth perception. Outcomes are of fundamental importance to understanding the visual pathways mediating depth perception. This knowledge could also prove useful in prescribing rehabilitation after brain injury or in designing robotic systems.

COMPLEX3D

- ★ Coordinated by the University of Birmingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150935_en.html





“The project team re-examined the debate on EU integration, looking at EU statehood restructuring and rescaling.”

SOCIAL SCIENCES AND HUMANITIES

REDEFINING CITIZENSHIP IN A GROWING EUROPE

An in-depth look at citizenship in Europe that considers economic, legal and social factors has helped to shed light on ideas of statehood and belonging.

Since the EU came into existence, the concept of statehood in Europe has evolved. EUCITISPACE-II (The space of citizenship in Europe) was an EU-funded project that looked at different definitions of European statehood, focusing on citizenship and EU spatial policies.

To achieve its aims, the project team re-examined the debate on EU integration, looking at EU statehood restructuring and rescaling. It published a manuscript for a book that outlines relevant EU citizenship policies, such as those on free movement and how this affects the concept of national territories and spaces. EUCITISPACE-II also demonstrated the value of analysing EU integration as a process of statehood restructuring, closely studying EU legislation as well as public controversies on EU citizenship and space.

Interestingly, the project looked at citizenship law as a dynamic set of processes and not as a legal status. It redefined EU citizenship as a set of acts and operations designed to trace its political effects and unravel its politicised nature. This also involved investigating distinctions within national citizenships and between them in Europe in the context of EU citizenship law.

In addition to legal, institutional and historic factors, the project team also focused on economic considerations, geographical proximities and enlargement in relation to EU citizenship. A notable project achievement in this respect was a workshop at the European Parliament on the current challenges for European citizenship in times of economic crisis.

The project published three papers on southern Europe and the crisis,

examining unemployment as a threat to social stability and cohesion. The papers also touched on encouraging a green economy to overcome challenges related to cohesion.

Innovative research on European integration was disseminated to both European and non-European audiences through several channels, fostering healthy debate on social cohesion and citizenship. The results of this project have certainly enlightened the debate on what it means to be an EU citizen.

EUCITISPACE-II

- ★ Coordinated by Université Libre de Bruxelles in Belgium.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150905_en.html
- ★ Project website: <https://eucitispacspace.wordpress.com/>

NEW EMPIRICAL RESEARCH FOR ACCOUNTANCY

A European research project has contributed to the body of knowledge on corporate debt financing and the particular relevance of accounting information.

Funded by the EU, the CUBE (Relevance of accounting information for corporate debt financing) project investigated the effects of changes in accounting regulations on financial statements. Research focused on the debt holders' perspective and the links between financial reporting, the legal and institutional environments, and the debt market.

Teaching, research, journal submissions and organisational activities were undertaken to promote the project and its findings. Two papers are being peer-reviewed and another has been accepted for publication in an EU-based journal.

The researchers also organised a summer school for doctoral/PhD students from nine European countries and the United States on the topic of empirical financial accounting research. The summer school included four international faculty members.

Findings were presented to the academic community, practitioners, regulators and policymakers through participation at conferences, seminars and workshops. CUBE has succeeded in generating and transferring knowledge on the economic effects of changes in accounting regulations. Project efforts also led to an extended and enhanced research network and

“CUBE has succeeded in generating and transferring knowledge on the economic effects of changes in accounting regulations.”

collaborations spanning Europe and the United States.

CUBE

★ Coordinated by Humboldt-Universität zu Berlin in Germany.

★ Funded under FP7-PEOPLE.

★ http://cordis.europa.eu/result/rcn/150943_en.html

AN IN-DEPTH LOOK AT BANKING STABILITY

New research on banking stability during the crisis and over the last 20 years has helped produce valuable findings and publications on the subject.



The global financial crisis has prompted experts and governments worldwide to investigate the dynamics of banking stability, banking competition, financial systems, regulatory frameworks and ownership of banks. The EU-funded project BANSYSREG (Banking system stability and bank regulation) took up this challenge and conducted an in-depth study of several key banking issues, producing a wealth of papers and findings on the topic.

In one confidential study, the project team demonstrated that private banks are less stable than government and cooperative banks. Publishing a paper on 'Bank Competition and Stability: Cross-country Heterogeneity', the team also showed how increased competition affects bank fragility, as well as

implications for current regulatory reform debate.

Another paper titled 'Bank Failure Resolution: A Conceptual Framework' discussed the trade-off in bank resolution between minimising the external costs of bank failure and imposing market discipline. The publication looked at how resolution is affected by regulatory, institutional and legal frameworks, as well as the variety of failure resolution tools and preferences in different banks.

Investigating how banks' international activities affect regulatory frameworks, the paper 'Supervising Cross-Border Banks: Theory, Evidence and Policy' outlined the impact of foreign assets and deposits on the economy. It specifically examined how national regulators deal with banks that have a higher share of foreign deposits and

assets, as well as a lower share of foreign equity.

Also noteworthy was the paper on 'Supranational Supervision: How Much and for Whom?' This informative working paper discussed supervision of banks on the supra-national level, guided by cross-border externalities from bank failures and heterogeneity in bank failure costs.

In addition, BANSYSREG supported new research related to the impacts of portfolio diversification and specialisation on bank stability. It helped compile a database resolution of bank issues and crises per country over the last two decades, touching on topics such as mergers, acquisitions, liquidation and restructuring. The research conducted and the papers offer valuable insights for supporting bank stability in the future.

BANSYSREG

★ Coordinated by Stichting Katholieke Universiteit, Brabant Universiteit van Tilburg in the Netherlands.

★ Funded under FP7-PEOPLE.

★ http://cordis.europa.eu/result/rcn/150860_en.html



ENERGY AND TRANSPORT

CLEAN BILL OF HEALTH FOR ELECTRIC CARS

Could electric cars cause cancer? Like all electric devices, and indeed like all motor vehicles, they do produce electromagnetic fields. However, these fields are far too weak to give cause for concern, say EU-funded scientists at the end of a comprehensive research project.

Energy-efficient, environmentally friendly and blissfully quiet: electric vehicles rank prominently among the technologies that could combine to make transport more sustainable. In terms of air quality alone, those of us living and working in urban areas would certainly notice the difference. Public health would benefit, some say, whereas others worry about our growing exposure to electromagnetic fields. Would we simply be swapping smog for e-smog?

Based on comprehensive research conducted over the course of three years, the EM-Safety (EM safety and Hazards Mitigation by proper EV design) project has reached the conclusion that the 'electromagnetic fields' (EMFs) in electric cars are well

within the safety limits. The partners measured the fields generated in test vehicles and analysed their biological effects. They have also produced designs for a particularly powerful sensor and developed guidelines that can help car manufacturers to reduce magnetic exposure even further.

In-vehicle measurements

'In our project,' says project coordinator Andreas Vogl from Stiffelsen SINTEF, 'we wanted to investigate EMFs in fully electric vehicles, see if there are reasons for concern and, if so, find ways to address them and introduce measures to reduce magnetic field exposure.'

To do so, the partners took measurements in 11 vehicles — 8 electric cars

of different makes, 2 running on petrol and 1 with a diesel engine. Their data indicates that the exposures in electric cars, while slightly higher than those with internal combustion engines, remained far below the limits defined by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The researchers reported maximum exposures amounting to 20% of the ICNIRP limits, compared to the 10% they observed in the three conventional cars.

These values relate to the exposure at foot height. Higher up, and therefore further away from the engine, the values are lower. The project reports that exposure levels nearer the head do not exceed 2% of the ICNIRP limits.

In vitro experiments

The partners also studied the biological effects of the EMFs observed in electric vehicles. One of their experiments focused on cardiac cells, to check if EMFs affect the electrical processes of the heart. Other tests looked into the fields' effects on other types of healthy and cancerous cells.

'We used the magnetic field exposure in the frequency area observed in the electric cars, and from these cell studies we couldn't see any negative effects,' says Vogl. More specifically, the partners conclude that there are no reasons to perceive the electromagnetic radiation observed in cars as potentially carcinogenic — in contrast to substances such as benzene or diesel exhaust fumes, which are known to cause cancer.

In-depth knowledge

While EM-Safety was not the first project of its kind, says Vogl, it was

particularly comprehensive, covering a wide range of cars and combining the findings with biological knowledge and engineering guidance. The complementary nature of the partners was crucial in this respect, with specialised, independent scientific institutions handling the measurements and biological experiments, and industrial partners contributing private sector expertise.

The project, says Vogl, has enabled all partners to refine their skills. They have applied their insights to the development of guidelines that will help car manufacturers to reduce electromagnetic exposure even further. The team has also developed a new sensor, which according to Vogl measures a broad frequency area of magnetic fields with particularly high resolution.

Insights from the project, says Vogl, are feeding into the development of a new standard for the assessment of electric, magnetic and electromagnetic

fields associated with human exposure. And for several partners, the project has opened up new opportunities, such as a chance to contribute to the development of a new electric bus and the necessary charging stations, and the production of innovative components.

“Electric vehicles rank prominently among the technologies that could combine to make transport more sustainable.”

EM-Safety

- ★ Coordinated by Stiftelsen Sintef in Norway.
- ★ Funded under FP7-TRANSPORT.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33459
- ★ Project website: <http://www.sintef.no/Projectweb/EM-Safety>

EXTENDING ORGANIC SOLAR CELL LIFETIME

EU-funded scientists have developed novel polymers to stabilise 'photovoltaic' (PV) cells for significantly longer operation time.

Organic photovoltaics' (OPVs) have been recently brought to the table mainly due to their inexpensive fabrication in large roll-to-roll films from relatively abundant materials. To date, however, OPV technology has suffered from limited lifetime; in the region of five years. Light-absorbing materials that harvest solar radiation need to be durable and not degrade over time.



© luanduan, Thinkstock

Against this backdrop, scientists working on the EU-funded project SYNABCO (Synthesis and application of block copolymers for interfacial stability in organic solar cells) sought to significantly prolong OPV lifetime by designing novel block copolymers.

These polymer layers were designed to improve device stability through low-energy equilibrium structures that hold the photoactive materials in place. Binding critical components together within the device should also boost power-conversion efficiency.

Two different block copolymer libraries were designed and synthesised. Using a new synthetic route, the block copolymers did not contain metal contaminants that are known to have a negative impact on device performance. The phase diagrams of both material libraries are currently under construction.

The effect of SYNABCO's new polymers on the lifetime and efficiency of real OPV devices is currently being tested. The project findings should enhance European competitiveness and provide a step change in the PV technology platform.

SYNABCO

- ★ Coordinated by Aston University in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150901_en.html

BIOFUEL FROM SEAWEED

There is an urgent need to find alternatives to fossil fuels, which are rapidly diminishing. One answer is to use biomass in the form of seaweed, which can be grown in nutrient-poor seas and therefore does not use land needed for food production.

Natural production of seaweed is approximately 1 tonne dry weight per hectare per year, which is much greater than for many terrestrial plants. Large amounts of seaweed, particularly kelp, are washed up on Europe's beaches every winter and can provide a renewable source of biofuel.

The SEAWEED AD (Anaerobic digestion of seaweed for biofuels) project examined the viability of using seaweed as an alternative to fossil fuels. The most cost-effective way to achieve this was the use of 'anaerobic digestion' (AD) — which is conducted without the presence of oxygen — to produce methane gas. The work was conducted at the laboratory scale, but it is hoped that in the near future the AD process will be tested at the pilot scale.

Project partners developed fermentation technologies and detoxification

processes, and employed metagenomic techniques to develop the most suitable microbial inoculums. These were used to produce methane biofuel from the AD of seaweeds. In addition, bioactive compounds released by the process were studied for additional value as pharmaceutical products or use in cosmetics.

Researchers identified the hydrolysis of seaweed polysaccharides as the limiting factor in the AD process. Inoculums comprising polysaccharide-hydrolysing bacteria and methane-producing archaea were found to increase methane productivity. The sources of the microorganisms were ruminants, digester leachate and marine mud.

One challenge was the presence of 'phlorotannins' (PTs), which were found in some species of seaweed and which cause toxicity. The PTs were neutralised



© Watcha, Thinkstock

through extraction and precipitation techniques. Extracted PT was found to be bioactive, displaying radical scavenging activity.

SEAWEED AD demonstrated that an optimised inoculum can be used to produce biomethane and bioactive products from seaweed. This will help to protect the European environment, while contributing to economic success through the development of new biotechnology.

SEAWEED AD

- ★ Coordinated by Centro de Ciências do Mar do Algarve in Portugal.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150890_en.html

REDUCING ENERGY USE AND NITROGEN IN WASTEWATER

Less energy-dependent wastewater treatment plants are now possible thanks to an EU-funded initiative that investigated the use of biofilms for nitrogen removal.

In regions such as Central Europe, the average temperature of wastewater is no higher than 15 degrees centigrade and can be even lower in Scandinavia. However, heating the entire wastewater stream to temperatures favourable for anaerobic digestion is not economically viable.

This problem was addressed by the EU-funded BIONIT (Biofilms in bioreactors for advanced nitrogen removal from wastewater) project.

“Magnetic resonance imaging was used to study transport patterns and to trace bio-available nutrients within the anaerobic granular biofilm.”

The consortium studied the temperature of municipal wastewater and biofilm bioreactors for nitrogen removal, combining anaerobic and aerobic

treatment technologies. Biofilms can be considered as groups of microorganisms sticking to one another on a surface.

Nitrification in biofilm reactors and denitrification in reactors with granular biomass have only been demonstrated at temperatures above 25 degrees centigrade. Therefore, the nitrification and denitrification processes need to be adapted for a lower temperature and the biofilms studied in both types of reactors.

This was achieved by operating nitrification moving bed biofilm reactors at different temperatures and using different technological parameters. The reactors were operated for over a year

in order to gauge their long-term performance. An alternative process was also examined through the operation of reactors for denitrification and anaerobic ammonia oxidation.

Research focused on the anaerobic granular biofilm and on transport processes within it. The microbial population in the denitrification biofilm was studied using fluorescence *in situ* hybridisation. This technology revealed the presence and amount of nitrite oxidising bacteria and ammonium oxidising bacteria in the biofilm grown in the reactors.

Magnetic resonance imaging was used to study transport patterns and to trace bio-available nutrients within the anaerobic granular biofilm. This was important because the transport of nitrogen and oxygen is crucial for controlling nitrification and denitrification processes.

BIONIT outcomes are slated to improve the ecological and economical aspects of municipal wastewater treatment in Europe. The result will be a reduction in the demand for energy from treatment plants, less excess sludge production and lower operational costs. This will help to improve the European environment and economy.

BIONIT

- ★ Coordinated by Vysoká Škola Chemicko-Technologická v Praze in the Czech Republic.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150884_en.html

AN ALL-ELECTRIC AIRCRAFT SYSTEM MODEL LIBRARY

Simulation software plays an important role in aircraft design. Novel libraries describing the behaviours of components destined for all-electric aircraft integrate seamlessly with other platforms for efficient testing of design concepts from very early on.

In the pursuit of all-electric aircraft concepts to reduce noise and greenhouse gas emissions, electro-mechanical actuators that replace conventional hydraulic systems will play an important role. They promise reduced weight in a simpler package with aircraft-standard reliability. Scientists require suitable models of their mechanical, electrical and thermal behaviour that can be interfaced with already-existing modelling and simulation software.

The EU-funded project E-BIRD (Development of numerical models for aircraft systems to be used within the JTI/GRA Shared Simulation Environment) has provided the solution. Researchers developed a library of models for electro-mechanical actuators and landing gear/

flight control system assemblies in Modelica®. The library is subdivided into landing gear, flight control system and electro-mechanical actuator models for greater flexibility in combining subroutines with other modelling and simulation software. The models are currently supporting the full electrical system simulation of the Green Regional Aircraft, an Integrated Technology Demonstrator.

Modelling and simulation software is critical to aircraft development, helping industry avoid extremely costly and time-consuming experimentation during initial design phases. E-BIRD's contribution to that domain is already having an important impact and is expected to find widespread application in the design of future green aircraft. This, in turn, will help

"The models are currently supporting the full electrical system simulation of the Green Regional Aircraft, an Integrated Technology Demonstrator."

reduce carbon dioxide emissions associated with air transport and therefore relieve the intense pressure human activity places on the planet's sustainability.

E-BIRD

- ★ Coordinated by TWT GMBH Science & Innovation in Germany.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/result/rcn/150599_en.html

GREENER CORROSION PROTECTION FOR HELICOPTERS

Corrosion poses a major threat to the function of safety-critical helicopter transmission components. Novel coating technology promises to safeguard aerospace investments, human life and the environment.

'Magnesium' (Mg) alloys are widely used in helicopter gearbox parts. Due to their high strength-to-weight ratio, they provide significant weight reduction compared to other structural metals, resulting in reductions in fuel usage and associated emissions. However, these benefits are offset by problems related to corrosion.

Building on a patented process and proprietary formulations of partners (TECNALIA and PROMET), the EU-funded project MAGNOLYA (Advanced environmentally friendly chemical surface treatments for cast magnesium helicopter transmission alloys preservation) developed an eco-friendly chemical conversion technology to protect helicopter transmission components made of Mg casting alloy EV31A, following the requirements of the topic manager AgustaWestland.

Conventional chemical methods to modify Mg surfaces employ environmentally hazardous materials, the most common of which are based on 'hexavalent chromium' (Cr(VI)) which is a known carcinogen. Promising alternative electrochemical methods are currently under development for aerospace applications, but certain areas, including oil ducts, are not treatable with electrochemical processes.

MAGNOLYA partners have extensive expertise in chemical conversion coatings. Using their knowledge as a starting point, they optimised the process in three main steps: (i) selecting the most suitable pre-treatment for the Mg substrate, a critical step in ensuring the remainder of the process is successful; (ii) incorporating additives to the base treatment to improve corrosion resistance and to impart self-healing properties; (iii) optimising the process parameters and formulations to deliver the best final performance.



© suggestion: descendre

The two most promising processes and formulations were scaled up to a 20-litre pilot plant to manufacture Cr(VI)-free Mg alloy plates. The samples were tested in terms of appearance, composition and morphology, mild environment and salt spray fog corrosion resistance, resin and primer adhesion and evaluation of the chemical resistance of the component. All the requirements for the testing procedures comply with the main standards and regulations set for the aeronautic industry. The resin and primer used to coat some of the samples for testing were Cr(VI)-free, according to industry requirements.

MAGNOLYA delivered a 100% Cr(VI)-free chemical conversion process that demonstrates excellent corrosion protection of Mg alloys used for helicopter transmission components. Its applicability to areas that may not be suitable for application of Cr(VI)-free electrochemical conversion methods makes an important contribution to the future of green air transport.

MAGNOLYA

- ★ Coordinated by Fundación Tecnalia Research & Innovation in Spain.
- ★ Funded under FP7-JTI.
- ★ http://cordis.europa.eu/result/rcn/150592_en.html



ENVIRONMENT AND SOCIETY

NEW VIRTUAL RESEARCH COMMUNITIES TO CREATE AND SHARE DATA ON BIODIVERSITY

Data sharing tools developed by an EU project are helping scientists worldwide understand more about the planet's millions of species.

One of the biggest challenges facing natural history experts is how to classify and share the mass of data constantly being collected on the Earth's millions of species.

“VIBRANT helps users prepare papers for publication, build bibliographic databases and create reference collections of images and observations.”

The three-year VIBRANT (Virtual Biodiversity Research and Access Network for Taxonomy) project developed a network of online scientific communities collecting data on biodiversity and equipped them with the tools for sharing and publishing their data. Through these activities, the

project contributed to reducing the fragmentation of efforts aimed at developing biodiversity informatics systems and software.

Based on Scratchpads, an open-source and free-to-use online platform, VIBRANT has helped create hundreds of new online communities.

The communities are linked together online and feed their data into the most important international biodiversity databases. VIBRANT helps users prepare papers for publication, build bibliographic databases and create reference collections of images and observations. A tool for rapid geospatial analysis of species distributions, a citizen-science marine monitoring platform as well as a biodiversity data analysis framework are also part of the ecosystem of services developed by VIBRANT.

Ants to bats, lobsters to whales

VIBRANT has grown the number of user communities from around 100 under EDIT, an earlier EU project, to over 580 today. Some 6 500 active users are investigating an enormous range of species, at global scale. One site alone on stick insects (phasmids) has over 1 000 users, revealing the large community of people interested in culturing phasmid species.

‘My taxonomic background is in parasitic lice, of which there are about 5 000 particular species that live on about 5 000 mammals and 10 000 birds. Fighting to study that group, I found it enormously difficult to manage all this information,’ explained VIBRANT coordinator Dr Vince Smith, of London’s Natural History Museum.

Using the Scratchpads template, professional and amateur scientists,

wherever they are based in the world, create their own subject-specific websites hosted at the museum.

They share their data by publishing it online, while retaining ownership over it and respecting the terms and conditions of the network set up by VIBRANT.

Scratchpads also provide ready access to a range of analytical tools, identification keys and databases that have been developed or enhanced throughout the project.

VIBRANT has also set up a novel, community peer-reviewed, open-access journal, the Biodiversity Data Journal (BDJ). Scratchpads users can input their research into a template which then makes it possible for them to produce a specific paper, publishing it internationally, online, in the BDJ and crediting them for the research. This is made possible via the development of the Pensoft Writing Tool (PWT), which is a leading example of the next generation of scholarly publishing. The

PWT is acting as an integrated authoring, peer-review publishing and online collaborative platform which links the Scratchpads to the BDJ.

Big data in the international conservation effort

VIBRANT helps all researchers to easily share and link their data with major biodiversity repositories. For example, the Scratchpads collaborate with the GBIF (Global Biodiversity Information Facility), the EU's PESI (Pan-European Species directories Infrastructure), the Biodiversity Heritage Library and the online collaborative Encyclopedia of Life, which is aiming to document all the planet's 1.9 million known living species.

Dr Thomas Couvreur in Cameroon looks after a Scratchpads community on African palms and the tropical plant family Annonaceae. 'They provide a professional platform for collaboration between my colleagues around the world, allowing us to share

resources such as photos of species, datasets, bibliographies and general information,' he commented. Another coordinator, Eli Sarnat, in California, USA, has one on ants: 'The platform has successfully addressed a big challenge for me: what biodiversity data I should be recording and how I should be recording it.'

The VIBRANT project ran from December 2010 to November 2013. It involved 17 partners from nine countries, was led by the Natural History Museum, London, and received FP7 funding of EUR 4.75 million.

VIBRANT

- ★ Coordinated by the Natural History Museum in the United Kingdom.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ http://cordis.europa.eu/project/rcn/95533_en.html
- ★ Project website: <http://vibrant.eu/>

CARNIVORE-HERBIVORE INTERPLAY IN FORESTS

A recent research project has advanced our understanding of the interaction between predators, herbivores and plants in the forests of Poland.

The temperate forest of Białowieża (Poland) belongs to one of the last remaining natural forests in Europe. Understanding the interplay between ungulate (hoofed) herbivores, their predators and the plants of the forest is important for the conservation of these ecosystems.

The EU-funded INTACT (Interacting effects of abiotics and carnivores shape herbivore top-down effects) project set out to study this interaction. Several experiments and observa-

“Contrary to other forests, browsing ungulates in the BPF appear to indirectly stimulate the regeneration of their preferred food plant species.”

tions were conducted in the Białowieża Primeval Forest (BPF) in Poland.

Contrary to other forests, browsing ungulates in the BPF appear to indirectly stimulate the regen-

eration of their preferred food plant species. Other tree species may regenerate despite high browsing pressure by native ungulate species as was shown for English oak (*Quercus robur*).

Another noteworthy finding was that coarse woody debris protects oak seedlings from browsing, especially in forest gaps. And interestingly, acorns were foraged more frequently (by voles and wild boar) in areas of coarse woody debris, but saplings were browsed less (by deer).

The influence of wolves (*Canis lupus*) on the browsing patterns of red deer was also studied. Researchers showed

that browsing behaviour changed when the deer were in wolf territories, thus demonstrating that predators indirectly influence tree regeneration in forests.

INTACT's work has broadened our scientific understanding of forest ecosystems. This will have an impact on ecosystem biology and forest conservation in temperate climates.

INTACT

- ★ Coordinated by Zakład Badania Ssaków Polskiej Akademii Nauk in Poland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150896_en.html



© Helly Kuchera - Thinkstock

MICROBES AND ORGANIC MATTER IN ARID SOIL

Scientists have investigated how introducing high-carbon organic matter into arid soils affects the communities of microorganisms found there.

It is well known that organic soil amendments can be used to restore desertified or arid soils. However, little is known about how this process occurs, or which microorganisms play a role.

As part of the EU-funded DYNOMIWAS (Dynamics of the organic matter and the microbial community related to its cycling in arid areas. Involvement of amendments based on organic wastes) project, researchers studied the dynamics of organic carbon and how it is metabolised by the microorganisms in arid soils.

They treated soils with different organic amendments, such as solid or liquid human municipal waste, and evaluated the effects on soils and microorganisms.

They found increased carbon content, increased activity of hydrolytic and dehydrogenase enzymes, and changes to the function but not the diversity of microbial communities.

DYNOMIWAS also investigated how carbon was sequestered into soil under the same conditions by using glucose or cellulose labelled with C13 (a radioactive isotope). Different microorganisms were responsible for metabolising glucose compared to cellulose, but in both cases only a small fraction of the community used the carbon.

Overall, DYNOMIWAS contributed to our understanding of how microorganisms interact with organic matter in arid soils.



©Brian Weed, Thinkstock

This may prove important for restoring desertified or over-farmed ecosystems.

DYNOMIWAS

- ★ Coordinated by Agencia Estatal Consejo Superior de Investigaciones Científicas in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150906_en.html

TRAINING AND RESEARCH SAFEGUARDS GROUNDWATER

Young environmental scientists have been trained in the major issues and processes relevant to groundwater vulnerability as part of an EU-funded initiative.

There is an increasing realisation that for water quality and quantity to be maintained, action is needed at both national and European levels. This is because Europe's groundwater resources are now facing a number of challenges which include pollution and over-abstraction.

Minimising these threats requires a better understanding of the physical, chemical and biological processes involved. This can be achieved by designing protection strategies and creating tools for assessing groundwater vulnerability and aiding water management. The water industry must also meet the requirements of the new EU Water and Groundwater Framework Directive.

As the European water industry expands, there will be an increasing demand for appropriately educated graduates. The EU-funded project IMVUL (Towards improved groundwater vulnerability assessment)

“Methods were developed to detect the hormone oestrogen, a major emerging pollutant, and related endocrine disruptors at nanogram/litre level.”

was set up to train young scientists to deal with the scientific and operational challenges facing the groundwater industry.

IMVUL's main objectives, therefore, were

to increase understanding of the processes involved in groundwater vulnerability. In addition, tools were developed to help protect and promote the sustainable use of groundwater and to act as an interface between the water industry and researchers.

Research activities covered three main areas: aquifer case studies, laboratory research and modelling techniques. Case studies were conducted across Europe and included: studies on using

groundwater temperature as a tracer; examining the response of borehole water levels to changing weather in order to assess groundwater vulnerability; an investigation into the nature of flow between the ground surface and the water table in fractured aquifers; and methods for minimising groundwater contamination from pollutants in recharge ponds.

Laboratory studies included an investigation into developing biofilms and controlling water quality. Methods were developed to detect the hormone oestrogen, a major emerging pollutant, and related endocrine disruptors at nanogram/litre level. Studies were also conducted into the effects of nutrient levels and heavy metal concentration on bacterial activity in the soil.

Furthermore, new analytical and numerical methods were developed and existing models improved. The result was a range of modelling tools for investigating aquifer vulnerability. In addition, researchers investigated flow, mixing, dispersion and transport in aquifers on a range of scales. The team further developed existing numerical models of flow and transport in fractured porous media to include precipitation and biofilm development. This resulted in more accurate predictions for groundwater flow and transport of contaminants in fractured rocks.

IMVUL's key results therefore include trained scientists and new tools, both contributing to protecting groundwater resources from pollution and over-abstraction. This in turn will help safeguard the European economy and the health of its citizens.

IMVUL

- ★ Coordinated by the University of Leeds in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150930_en.html

EFFECT OF ZOOPLANKTON ON ECOSYSTEMS

Zooplankton plays a crucial role in aquatic food webs and helps sequester carbon from the atmosphere to the deep sea. An EU-funded project was established to determine how chemical stressors influence zooplankton populations and how these populations can affect the entire ecosystem.

Various chemicals, such as toxins produced by cyanobacteria and man-made pesticides, and natural factors, such as predation and competition for food, can alter zooplankton populations. Plankton must employ different strategies to deal with these challenges, but these strategies exclude one another, which can result in a loss of genetic diversity or even an entire species.

The CONTRASTRESS (Contradicting responses to multiple stressors reduce the resilience of zooplankton community) project studied the different strategies used by zooplankton. Researchers investigated how individual populations dealt with different conditions and their role in the loss of biodiversity.

Moderate stress, such as that produced by bad food conditions or small doses of toxicants, can cause *Daphnia* (commonly called water fleas) to grow bigger and produce larger offspring. This is because larger individuals can cope better with toxins than smaller ones. However, the

larger size makes *Daphnia* more vulnerable to predators such as fish.

Sediment cores were taken from lakes known for cyanobacteria blooms and good ecological conditions in the past. This enabled the life strategies of *Daphnia* that were experienced with cyanobacteria to be compared with those that were not. They were also used for hatching experiments with *Daphnia*.

Several concentrations of cyanobacteria were tested on *Daphnia*. It was already known that cyanobacteria interfere with the filtering apparatus of larger *Daphnia*, thereby significantly hindering their ability to feed. The results of the experiments confirmed the absence of larger species and the effect on biodiversity.

The results of the CONTRASTRESS project have contributed to research into the ecology of lake plankton and provided a better understanding of the relationship between zooplankton, cyanobacteria and algae. This will enable better management of the environment and any future

restoration programmes for inland waters.

CONTRASTRESS

- ★ Coordinated by Uniwersytet im. Adama Mickiewicza w Poznaniu in Poland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150936_en.html



© micro-photo, Thinkstock

UNDERSTANDING THE ARCTIC

An EU-funded project has identified challenges to intensifying state governance in the Arctic.

Considered a unique ecosystem on Earth with its varied yet endangered biodiversity, the Arctic is also a treasure of natural resources such as gas, oil, minerals, fish and fresh water and home to some 4 million people. The region is also crucial for understanding and measuring climate change, an important development that could affect our world significantly. While no country owns the region, surrounding nations do have claim to certain parts, spurring several political disputes and raising important geopolitical issues.



© Stocktrek Images, Thinkstock

The EU-funded project GAIA (Global alternatives for an interconnected arctic) analysed assumptions underlying the range of governance models that have been proposed for the Arctic. The project team published a book titled 'Contesting the Arctic: Politics and Imaginaries in the Circumpolar North'. The book builds on previous and current research to examine how different visions for the Arctic's future are grounded in specific understandings of the Arctic as geophysically and culturally distinct from other regions.

Perceptions of the Arctic range from those that see the region as a zone of impenetrable ice to those that see it as an indigenous homeland where ideas of 'belonging' and 'place' transcend state identity. These visions are increasingly being subsumed by one in which the Arctic is understood as a space of state-building, resource extraction, and economic and social development. Nonetheless, acknowledgment of Arctic exceptionalism continues to inform governance proposals and practices.

Against this background, the project team looked into the status of the Northwest Passage connecting the

Atlantic and Pacific through the Arctic. It proposed that the ongoing dispute between the United States and Canada could be settled if the Northwest Passage were reclassified as mainly frozen, territorial waters. This proposal could pave the way for overcoming other issues, for example in Russia's Northern Sea Route, and thereby help secure Europe's oil and gas supplies.

Other topics investigated include managing inland seas, preparing for offshore oil and gas hazards, regulating resource extraction, and maintaining indigenous representation in forums like the Arctic Council. In each of these cases, researchers sought to understand how innovative institutions might be maintained or enhanced even as the Arctic is increasingly managed as a space of state-governed territories and commons.

GAIA

- ★ Coordinated by Royal Holloway and Bedford New College in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150933_en.html



IT AND TELECOMMUNICATIONS

INFORMATION TECHNOLOGY FOR PEOPLE WITH DOWN'S SYNDROME

An EU project involving ICT research is producing visual and touch apps to help people with Down's syndrome become more independent in their daily lives.

Many people with 'Down's syndrome' (DS) face barriers to taking part in community activities the rest of us take for granted. Whether it's travelling on public transport, paying for items in a supermarket or getting to appointments on time, there may be times when they need help, especially if they get into difficulties.

"Many people with DS cannot take advantage of the standard functionality, since it is not adapted to their skills and abilities."

The EU-funded POSEIDON project (PersOnalized Smart Environments to increase Inclusion of people with Down's syndrome) is an exciting three-year project running until November 2016. Its aims include using information technology to help people with DS achieve: a greater level of independence in their lives; more autonomy at home, at work, in education and during leisure time; and increased opportunities for socialising. The types of technology being developed in the project include apps for tablets and smartphones, virtual reality programmes and interactive tables.

Tools for learning and travelling safely

Knut Melhuus, a young Norwegian with DS, will be one of those users testing some of the apps POSEIDON produces. He confesses to being a bit of a technology nut: He owns a tablet, a smartphone and a PC, and regularly phones, emails and sends SMS messages to his friends. 'Technology is "awesomely useful",' he says enthusiastically. 'I use the calendar a lot for appointments and birthdays. Then I can see what I'm supposed to do, like remind Mum about something, or send someone an SMS when it's their

birthday. I also use social networks, like Facebook and Snapchat.’

One of the apps the POSEIDON partners in the UK, Germany and Norway are designing is a calendar which displays the day’s events in a simple way, and links in with school timetables, weather information and instruction videos. On a given day, for instance, it will tell the user which schoolbooks to pack, which clothes and shoes would be most suitable to wear, and whether he or she needs an umbrella or not.

‘We want to give people with Down’s syndrome additional support in comparison to that provided by standard smartphones and tablets,’ explained POSEIDON coordinator Terje Grimstad, of Karde AS, an innovative product developer in Norway. ‘Many people with DS cannot take advantage of the standard functionality, since it is not adapted to their skills and abilities.’

The partners are taking a user-centric approach, examining the needs of around 20 people with DS and their families, as well as carers and teachers. The prototypes they are seeking to develop and are beginning to test with the target group include virtual and photo-based navigation apps, and

tables with touch and free-air gesture technology which interact with large screens that could be useful in classrooms. They are also looking at shopping apps which help when it comes to handling money.

High level of tailor-making required

Questionnaires have been sent out through DS associations in 10 countries in Europe. Two user workshops were also held earlier this year — in Oslo and Mainz, Germany — to try out a few ideas. Hundreds of replies to the questionnaires were received and, along with what was learned in the workshops, reveal that people with DS are generally familiar with ICT equipment. Some 85% and 57% of them already use tablets and smartphones, respectively. The project partners will be running a pilot phase with families starting mid-2015 and hope to introduce their first apps to the market in early 2016, after which they will hold a third workshop in the UK in Autumn 2016.

One of the key conclusions at this early stage is that the apps need to enable a high degree of tailor-making. ‘One size doesn’t fit all,’ says Terje.

‘People with DS and their carers need to be able to load in, for example, their own timetables, instruction videos and transport information and photographs. Norway looks very different when there’s snow on the ground! Currencies are another issue, whether it’s the euro, pound or krone.’

The partners also want the platform they are building to be widely available to other system developers worldwide to enable them to develop new apps for the target group. They plan to talk to technology companies in the project’s final year about how their results can be used on a bigger scale.

POSEIDON is a three-year project involving nine partners from four countries and runs until 31 October 2016. It is receiving EUR 3 million from FP7.

POSEIDON

- ★ Coordinated by Karde AS in Norway.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/result/rcn/151858_en.html
- ★ Project website: <http://www.poseidon-project.org/>

ALL-OPTICAL INFORMATION PROCESSING

EU-funded scientists have set out to develop an all-optical ‘Liquid-state machine’ (LSM) based on a complex network of lasers. This should allow machine-learning computations to be carried out at unprecedented speed and using low energy consumption.

Reservoir computing represents a new paradigm in information processing, based on the idea that computational power can emerge from system complexity. The central part of the setup is a vast non-linear network — the reservoir — with nodes needed for information exchange. The connections to the output layer are trained to read the state and map it to the desired output.

The EU-funded project NOVALIS (A novel architecture for a photonics liquid state machine) aimed to develop a novel photonic approach to reservoir computing based on an LSM, which is a major type of it. The idea was to replace the network by lasers, acting as nodes. These nodes were highly non-linear in order to provide the complex dynamics necessary for computations.

Implementation of these nodes was achieved by using ‘semiconductor lasers’ (SLs) with delayed feedback. Optical information injection with 5 Gsamples/s sample rates revealed impressive single SL information-processing capacity. Coupling and feedback were then established for a two-SL system by using polarisation-maintaining optical fibres. However, scientists could not obtain computation results because of slowly varying modulation at the output intensities.



Another implementation of LSMs was a ‘Vertical-cavity surface-emitting laser’ (VCSEL) array that was embedded in a cavity, delay-coupling several laser diodes. Consequently, a

complex network was formed, consisting of the connections between individual diodes. This delay network acted as the reservoir. Compared to the previous individually coupled elements, this approach showed major advantages in terms of truly parallel computing, scalability and flexibility.

“To avoid the slowly varying amplitude variation, a method based on an all-optical classifier was used to map the liquid state of the VCSEL network.”

The final project activity for demonstrating parallel information processing was based on spatial light modulators. To avoid the slowly varying amplitude variation, a method based on an all-optical classifier was used to map the liquid state of the VCSEL network. Nevertheless, the detector showed noise

levels comparable to the induced transient amplitudes. To demonstrate parallel computing, an all-optical LSM using a single delay-coupled laser reservoir was successfully used.

NOVALIS represented a significant effort to implement an all-optical LSM based on multiple laser reservoirs. Overcoming the detector noise problem and implementing the training procedure should establish a novel all-optical, stand-alone machine-learning concept.

NOVALIS

- ★ Coordinated by Agencia Estatal Consejo Superior de Investigaciones Científicas in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150911_en.html

GAMING TECHNOLOGY MAKES ITS WAY INTO HEADSETS FOR THE VISUALLY IMPAIRED

EU researchers have developed a 3D headset that could help visually impaired people move around more safely and easily.



of visual impairment that takes their needs beyond normal glasses, the market for DIGIGLASSES' innovative headset is clear to see.

In parallel with the marketing opportunities, the project's central objective is to help those affected access work, education and social activities more easily, thereby helping the visually impaired to have a similar standard of living as the rest of society. To achieve this, the project is harnessing technology similar to that used by the gaming industry.

The headset has now been tested with the help of specialised trainers who work with visually impaired people to assist them in getting the most out of new devices and tools, and with volunteers who are directly affected. Successful trials mean the SMEs taking part in the project are now keen to develop the prototype into a marketable device and release it by the end of next year.

The headset comprises a pair of digital glasses, custom electronics and software, cameras and a processor similar to that found in smartphones. The user sees stereoscopic images which have been enhanced by the software.

The nature of that enhancement depends on the condition the user has. For example, contrast can be increased, edges of stairs or pavement curbs clearly accentuated, borders of zebra crossings overlaid with red lines, and so on.

The optical element has a micro display which acts like a small television with

high brightness and resolution. Magnifying optics using lenses and prisms turn the image from a small display into what appears to be a big screen.

In the past, similar head-mounted displays have been used by the gaming and video industry — but the innovative element of the DIGIGLASSES project is that it is applying the technology to potentially enhance lives.

The project's consortium brings together eight partners, spanning research, production and marketing, from across five countries.

“The project's central objective is to help those affected access work, education and social activities more easily, thereby helping the visually impaired to have a similar standard of living as the rest of society”

The EU-funded DIGIGLASSES (Development of 3D digital glasses for enhancing mobility of visually impaired people to open strategic product lines for participant SMEs) project, which kicked off in 2012, set out to develop a marketable digital tool for the visually impaired using stereoscopic vision, corrected and customised for the specific symptoms of the user's eye disease. The project's latest YouTube video announces the opening of product lines for participating SMEs. The project hopes the product will be on the market at the end of 2015.

With around 5 million people in Europe (285 million globally) living with a degree

DIGIGLASSES

- ★ Coordinated by Ateknea Solutions Hungary KFT in Hungary.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/news/rcn/122121_en.html
- ★ Project website: <http://www.digiglasses.eu/>
- ★ <http://bit.ly/1yvgALC>

THE WORLD'S MOST ADVANCED BIONIC HAND

A prosthetic hand, which provides a sense of touch acute enough to handle an egg, has been produced and is now being exploited by the NEBIAS (NEurocontrolled BIdirectional Artificial upper limb and hand prothesiS) project after 10 years of EU-funded research. The world's most advanced bionic hand was tested with the help of amputee Dennis Aabo Sørensen who was able to grasp objects intuitively and identify what he was touching, while blindfolded.

Researchers have created a new neural interface to provide sensory information from an artificial hand to the brain. This interface is able to link the patient's nervous system with the artificial sensors, embedded in the prosthesis, enabling the user to control complex hand and finger movements.

Mr Sørensen, whose hand was amputated 10 years ago, has been participating in the project's experiments, 'They gave me a baseball to hold and for the first time in a decade I could feel I was holding something round in my prosthetic hand.'

To make it possible for Mr Sørensen to feel the shape of the object he was holding, the researchers first had to develop a selective, implantable neuro-interface. 'Selective means, for example, that when I'm talking to you in a crowd, I'm not talking to a guy sitting close to you. In other words, the electrodes have an interface with some areas of the nerves and not with others close by,' explains project coordinator Dr Silvestro Micera. Dr Micera and his team enhanced the artificial hand with sensors that detect information about touch, which is sent in real time to the patient, allowing for the natural control of the hand.

With the prototype passing its initial tests with flying colours, the next stage is to identify two or three people to test the prosthesis over a few years, with all the elements being portable, wearable or implanted. If that works, in five or six years from now the final stage would be a large-scale clinical trial to establish if the prosthesis can be used widely. Dr Micera firmly believes the prosthesis will be available in 10 years' time.

Need for long-term funding

NEBIAS is a continuation of intensive multi-disciplinary research in this field which started many years ago with the CYBERHAND 'Future and emerging technologies' (FET) FP5 project (2002-05). While CYBERHAND was able to demonstrate a mechanical hand, the task of direct interfacing to the nervous system to enable natural control proved to be beyond the project's reach. Efforts to connect robotic artefacts to the nervous system were pursued notably under FP6 and FP7, with successful testing of a prototype electrode without sensory feedback and with an investigation on how electrodes could be implanted into a patient's nerve. The sensory feedback challenge was overcome only recently, and NEBIAS, also a FET-funded project, is now fully exploiting the prosthesis and further developing the technology for bionic arms.

Building on the results of successive projects means that the various challenges can be overcome and the technology refined, resulting in groundbreaking innovation that



may well enhance the lives of amputees across Europe and beyond.

Innovation through collaboration

This multi-disciplinary research brought together researchers from materials-, computer- and neuro-sciences, biomedical microtechnology and electronic engineering. In these different EU-funded projects, scientists from 29 institutions and seven EU countries (as well as the USA) worked together with just one goal in mind — to make a prosthetic hand that can enable natural sensation and motion.

'This is one of the things I love about the EU,' says Dr Micera. 'These transnational projects are amazing. You can draw on a pool of over 500 million inhabitants to find the best researchers in different fields.'

NEBIAS was launched at the start of November 2013 and will run for four years. It is receiving EUR 3.4 million from the European Commission's 7th Framework Programme.

NEBIAS

- ★ Coordinated by Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna in Italy.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/result/rcn/150378_en.html
- ★ Project website: <http://www.nebias-project.eu/>

FASTER FIBRE OPTIC CABLE OFFERS NEW ERA IN DATA TRANSMISSION

Researchers from the EU-funded MODE-GAP project have set a record for the speed of data transmission using a fibre optic cable.

Eindhoven University of Technology (TU/e) in the Netherlands and the University of Central Florida (CREOL) in the USA have been working together under the EU-funded MODE-GAP (Multi-mode capacity enhancement with PBG [photonic band gap] fibre) project to find a way of overcoming the optical transmission capacity problems caused by the demands of our connected society. They have succeeded in setting a record for the speed of data transmission using a fibre optic cable: 21 times the bandwidth and 20 times the speed currently available.

“The new fibre has seven different cores through which the light can travel, instead of one in current leading fibres, and introduces two additional orthogonal dimensions for data transportation.”

If the fibre optic cable developed by the FP7-funded R&D project MODE-GAP is rolled out, it will transmit at the speed of 255 ‘Terabits per second’ (Tbps) over one kilometre. The current standard is 4–8 Tbps.

The impact of this development could be felt in our daily lives, as the popularity of internet services and the emergence of capacity-hungry data centres means that our demand for bandwidth will grow exponentially. One area of focus of the European Commission’s Horizon 2020 Programme is to achieve Petrabits per second transmission in a bid to avoid capacity crunch — the MODE-GAP project brings us one step closer to achieving this goal.

One option for increasing the transmission of more information through current optical glass fibres is to increase the power of the signals, so as to overcome the losses inherent in the use of the glass contained in the cables. But increasing the power can limit the amount of information that can be recovered after transmission over the standard fibre.

The new fibre has seven different cores through which the light can travel, instead of one in current

leading fibres, and introduces two additional orthogonal dimensions for data transportation. The team at TU/e and CREOL, led by Dr Chigo Okonkwo, an Assistant Professor in the Electro-Optical Communications (ECO) research group, and Dr Rodrigo Amezcua Correa, a Research Assistant Professor in Microstructured fibres at CREOL, have shown that their new class of fibre can increase transmission capacity.

As Dr Chigo Okonkwo explains, the 200-micron diameter of the multi-core fibre means it is close to conventional fibres now deployed, but takes up less space.

The project is not resting on its laurels: its stated aim is to achieve a 100-fold enhancement of overall capacity and put Europe in the lead when it comes to developing the next generation internet infrastructure. MODE-GAP, which is coordinated by the University of Southampton in the UK, maintains radical approaches will be needed to avoid gridlock on the internet.

It is developing multi-mode, photonic band gap, long-haul transmission fibres and associated enabling technologies to find a way to achieve the project’s goal. MODE-GAP has brought together nine institutions from five European countries to work towards this, along with international partners in China and the USA.



© moodboard, Thinkstock

MODE-GAP

- ★ Coordinated by the University of Southampton in the United Kingdom.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/news/rcn/122089_en.html
- ★ Project website: <http://modegap.eu/>
- ★ <http://bit.ly/1BCVWqt>

“The economic potential for seaweed is huge. Businesses are interested in seaweed for many different applications such as food and food additives, animal feed, chemicals and even fuel.”

INDUSTRIAL TECHNOLOGIES

INNOVATIVE TEXTILES TO BOOST EU SEAWEED FARMING

Seaweed is an important but under-exploited resource for food and feed ingredients, biochemicals and the production of biofuels. But it has been difficult to harvest efficiently on a large scale... until now. An EU-funded project has developed advanced textiles that give high yields from floating seaweed farms and allow for easy, mechanised cultivation.

Project coordinator of the EU-funded AT~SEA (Advanced Textiles For Open Sea Biomass Cultivation) project, Bert Groenendaal from Belgium-based Sioen Industries, said that farming seaweed on the scale made possible by the new textiles can help create a multi-billion euro industry in Europe — boosting growth and jobs. Sioen is one of seven companies involved in the project, along with four research centres.

He said: ‘The economic potential for seaweed is huge. Businesses are interested in seaweed for many different applications such as food and food additives, animal feed, chemicals and even fuel.’

European Research, Innovation and Science Commissioner Máire Geoghegan-Quinn said: ‘AT~SEA is just one example among many of how EU funding helps researchers and businesses collaborate to innovate. This research will allow EU businesses to farm a valuable resource efficiently,

helping them compete in global markets. Horizon 2020, the EU’s new EUR 80 billion research programme supports companies and businesses in bringing new ideas from lab to market quickly and cost-effectively.’

Tests of AT~SEA’s textiles at trial sites in Solund, Norway, Oban, Scotland and Galway, Ireland have produced yields of up to 16 kg of wet seaweed per square metre — three to five times the yield of traditional seaweed farming.

Currently, seaweed is obtained by harvesting wild seaweed or by rope-based cultivation. Neither of these scales up easily, as both methods are labour intensive with relatively low yields.

The project team developed textiles that can support large numbers of seaweed plants without breaking up or attracting unwanted plants or molluscs. Bio-sourced coatings on the textiles protect young seaweed and boost growth.

The textiles are suitable for large, 1 mm thin mats on which seaweed plants grow, held a couple of metres below the sea’s surface. When the seaweed is fully grown, ship-based machines cut the plants from the mats and direct them to flexible storage tanks made from AT~SEA’s advanced textiles.

In September 2014, AT~SEA started cultivating 200 square metres of mats at each of the three trial sites. The aim was to evaluate their potential for commercial use. Groenendaal estimated that yields could increase to 20–25 kg per square metre as the consortium refines its techniques.

The AT~SEA consortium has applied for a patent on the textiles. After the project ends in July 2015, the consortium plans to establish a 2 to 3 hectare cultivation site through a commercial company to be spun off from AT~SEA.

The project also sees commercial uses for the textiles beyond seaweed cultivation. These uses include other types of aquaculture and flexible containers for transporting fresh water by sea.

There are many potential uses for seaweed. Some are sources of biochemicals for medicines, natural cosmetics and organic fertilisers. Others show promise for sustainable biofuel production if harvested in the quantities needed for industrial production.

Food and food ingredients are yet another potential use. Some species are farmed extensively and eaten directly in Asian countries. Here in Europe, processed drinks and food such as chocolate milk, yoghurts, health drinks and beer contain seaweed polysaccharides such as agars, carrageenans and alginates as binders or emulsifiers. High-value lipids and proteins, antioxidants, gelling agents, vitamins and essential minerals can also be extracted from seaweed for food production.

Large-scale seaweed farming could also have a positive impact on the ocean's ecosystem. Farmed seaweed can help absorb excess CO₂ in seawater and waste nutrients from nearby fish farms. It also provides safe habitats for wild fish and shellfish that might otherwise be threatened by fishing.

Background on the project

The AT-SEA project, supported with EUR 3.4 million in EU funding, brought together six SMEs, one large company and four research centres from Belgium, Ireland, Morocco, the Netherlands, Norway, Portugal, Spain and the UK.

The project received funding under the European Union's Seventh Framework Programme for Research and Technological Development (2007-13).

On 1 January 2014, the European Union launched a new, seven-year research and innovation funding programme called Horizon 2020. Over the next seven years, almost EUR 80 billion will

be invested in research and innovation projects to support Europe's economic competitiveness and extend the frontiers of human knowledge. The EU research budget is focused mainly on improving everyday life in areas like health, the environment, transport, food and energy. Research partnerships with the pharmaceutical, aerospace, car and electronics industries also encourage private-sector investment in support of future growth and high-skilled job creation. Horizon 2020 will have an even greater focus on turning excellent ideas into marketable products, processes and services.

AT-SEA

- ★ Coordinated by Sioen Industries NV in Belgium.
 - ★ Funded under FP7-NMP.
 - ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33396
 - ★ Project website: <http://www.atsea-project.eu>
-

PHOTONIC INTEGRATED CIRCUITS COME OF AGE

Photonics are permeating all aspects of everyday life, from optical telecommunications networks to precise household sensors. As the number of photonic devices explodes, an EU-funded project has paved the way from discrete components to 'Photonic integrated circuits' (PICs).



Many devices like amplifiers, multiplexers, de-multiplexers, lasers, attenuators and detectors can be integrated onto an 'integrated circuit' (IC). In its electronic forms, the IC is now incredibly mature, but the same cannot be said for its photonic counterpart. That's partly because more than 95% of electronic ICs are made with silicon, while different materials are employed for the fabrication of PICs.

This diversity in materials is reducing the advantages that come with scaling. The prospect of large-scale integration with dozens to hundreds of components integrated on a single chip motivated the EU-funded PICS (Photonic integrated circuit and systems) project. Researchers leveraged the existing manufacturing base to develop new types of ICs.

At the Scuola Superiore Sant'Anna in Pisa, Italy, the infrastructure needed to conduct leading-edge research into photonic devices and PICs was built. This included simulation software for designing photonics components, materials required for the fabrication of PICs and, more importantly, a clean room fitted out with state-of-the-art equipment. Through the PICS project, good working relationships were also established with experts from the industry and academia.

A common theme of the research conducted within the PICS project was development and characterisation of photonics devices for applications in telecommunications networks. Among the results was a monolithic PIC enabling all-optical wavelength conversion and a multilevel transmitter covering various modulation formats. Tunable chip-scale optical transmitters and receivers were also developed to enhance network flexibility.

The PICS project was terminated early. However, a new centre for photonics technologies was introduced to fundamentally change the way applications based on PICs are developed. Engaged in partnership with related industries, the Scuola Superiore Sant'Anna will be actively involved in developing cost-effective PICs for various applications, providing Europe with a competitive advantage.

PICS

- ★ Coordinated by Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150939_en.html
- ★ Project website: <http://www.fp7-pics.eu>

MAGAZINE EXCLUSIVE

HIGH-TECH, TAILORED EQUIPMENT FOR FIRST RESPONDERS

Acknowledging the problems faced by first responders who often have inadequate equipment, stakeholders have gathered together to develop a new-generation protective ensemble. The consortium is now hoping to sell its suite of products over the next 18 months.

In popular imagination, first responders often appear as setting the bar for braveness. From dealing with major health threats and security threats, such as the September 11 attacks, as well as earthquakes, Ebola epidemics and fires, they are known for putting their lives at risk when trying to save those of others. And while there is no such thing as zero risk in such interventions, there will always be a need to make their equipment safer and more effective.

'Much of the current generation of first responder 'Personal protective equipment' (PPE) was originally designed and tested for the military,' says Dr Catherine Bertrand from SAMU, the French medical emergency service. 'They were created for dealing with chemical or biological agents at levels far higher than those faced by civilian responders. Apart from this, there are actions and activities unique to soldiers and first responders, however the latest generation of suits is only appropriate for one of these groups.' For civilian first responders, this often results in suits bearing a far higher physiological burden than necessary, which means the responders can find themselves in a situation where they are either unable to do certain tasks or able to but not for as long as required.

"As opposed to a 'one size fits most' approach, we have delivered a suite of products that can be tailored to a specific challenge."

Dr Bertrand is the coordinator of the EU-backed IFREACT (Improved First Responder Ensembles Against CBRN Terrorism) project, which aimed to deliver a next-generation protective ensemble for police, fire fighters, health professionals and other first responders so that they can better deal with threats from chemical,

biological, radiological and nuclear incidents. The project ended in December and delivered an ensemble that redefines the state-of-the-art.

'As opposed to a "one size fits most" approach, we have delivered a suite of products that can be tailored to a specific challenge. The suit — developed by Blücher — can adapt to both the threat faced by the first responder and the environment. Furthermore, our partner NBC SYS designed an overpressure hood to replace the rather cumbersome respirator which might not be necessary for all missions. The hood provides a good level of respiratory protection but also allows a large part of the face to remain visible — so that all non-verbal communication can be seen,' explains Bertrand.

More than the sum of its parts

A second problem with current PPE, also spotted by IFREACT, is the lack of holistic connections between components. 'Customers tend to buy the component elements in a piecemeal fashion: when the suit wears out they'll buy another, and in five years they will do the same for the respirator. The problem is that these two items have not been designed to operate together. It is likely that the mask-hood interface has not been optimised, for example, and this could mean that a dangerous amount of chemical agent is able to enter inside the suit,' Bertrand says.

On the contrary, IFREACT has been designed as an ensemble where the suit, the overpressure hood and the respirator have all been through a lengthy integration process to prevent the protection from being compromised. The load carriage was also factored in at the beginning of the development process to prevent it from deforming or damaging the suit. This is actually the first time that suit, respirator and add-on companies



© Julien Trombin, Thinkstock

have worked together right from the start to make sure that the equipment is top-notch.

The new equipment is also packed with high-tech features. An example is a bio-collector that 'breathes' the air and keeps it safe for further analysis. 'This has a range of uses far beyond just chemical and biological terrorism,' Bertrand says. 'For example, when a building collapses it releases a vast number of harmful particles into the air which may lead to an immediate, delayed or protracted threat to life and health. The ability to tell an individual that he or she has inadvertently been exposed to these substances allows medical countermeasures to be used promptly.'

Then comes the head-up display and its associated software which, according to Dr Bertrand, generated a lot of

excitement amongst first responders. Easily mounted on the outside of the respirator, the system makes triage more efficient by removing the need to read triage tags. It displays a map which helps locate certain types of injured individuals. Finally, the 'communications bubble' is a communication network in a briefcase-sized box, effortlessly allowing voice and data to be passed between responders when no other means of communication are available. 'Traditional voice communication is difficult through a respirator so we also devised a microphone and in ear system to allow clearer exchanges between the HQ and team members,' Bertrand says.

Collaborative success

Since its inception, IFREACT has been focused on bringing all stakeholders together for the development of a commercially viable product. 'Bringing first responders like ourselves, and the Croatian disaster management organisation, DUZS, into the project, allowed countless small "course corrections" to be made. Even though these are not major changes, this means industrial entities are able to better understand the problems we face and the solutions that we need,' Bertrand points out.

The consortium has already received orders thanks to the work of its dissemination partners, and Dr Bertrand hopes that some, if not all, of the ensembles

will be bought within the next 18 months. 'At the end of the project, it will be harder for potential clients to contact us as an entity, but we are hopeful that the bonds formed in the project will enable us to continue working together even after the end of the consortium,' she concludes.

IFREACT

- ★ Coordinated by UNIVERSITE PARIS XII — VAL DE MARNE in France.
- ★ Funded under FP7-SECURITY.
- ★ http://cordis.europa.eu/project/rcn/101817_en.html
- ★ Project website: <http://www.ifreact.eu/>
- ★  <http://bit.ly/14mzTcF>

FILLING IN THE (NANOTUBE) GAPS

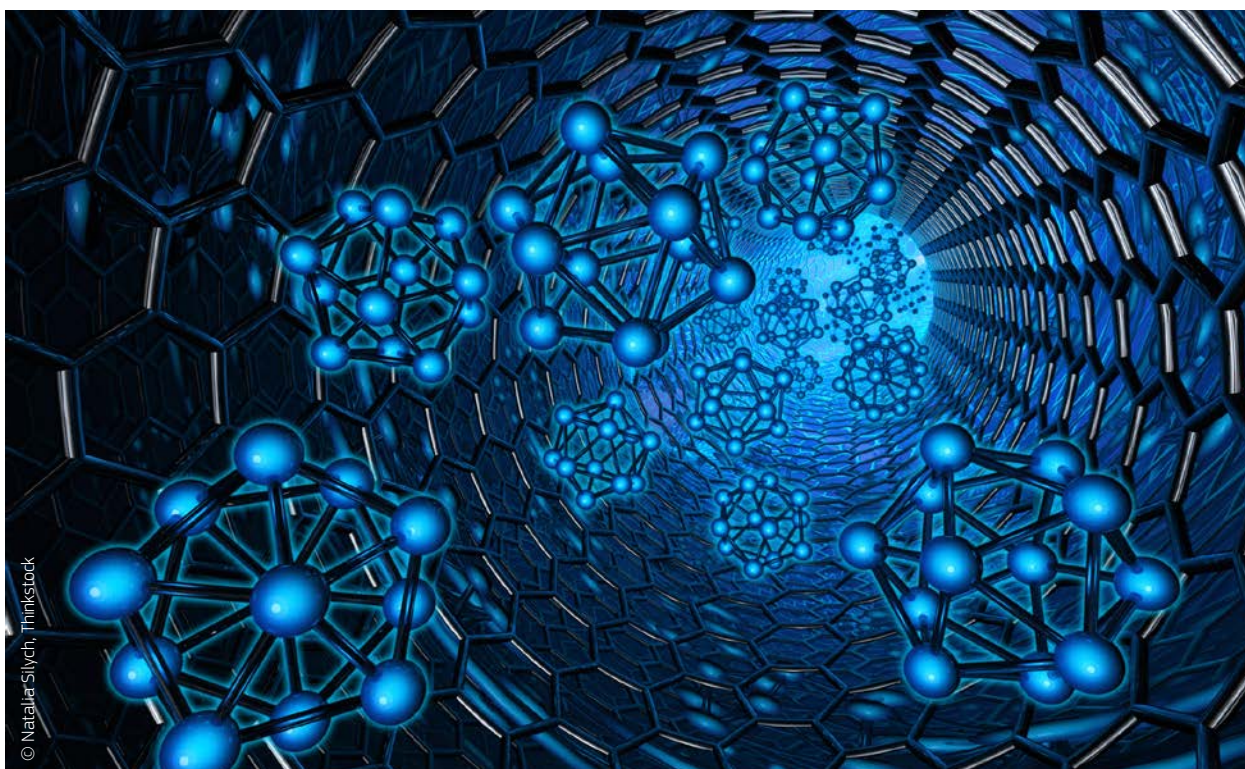
EU-funded scientists have developed novel electro-optical architectures based on nanotubes and the deposition of polymers either in or around them. The results should prove valuable for light-harvesting and photonics devices.

Titanium dioxide (titania) is an important metal oxide semiconductor and is also sensitive to ultraviolet light. In nanotube form, it has a very large surface area compared to its diameter, leading to interesting interactions with other materials at their interfaces. EU-funded scientists have developed novel architectures based on the interfaces between titania nanotubes and intrinsically conductive polymers.

Under the project NANOICP (Self-organized TiO₂ nanotubes-intrinsically conductive polymer composite material

for applications in solar cells, biomedicine systems, and electro-chromic devices), researchers exploited electrodeposition for polymer deposition inside the tubes and/or in the free space among the tube walls. They were able to control polymerisation and the final geometry of the titania network through making modifications to the current/voltage protocols. Polymers varying in size from 10 to 150 nanometres were produced.

NANOICP demonstrated the control of charge transfer across the vertically aligned titania (ultraviolet-sensitive)



“They created nanowires through electrodeposition inside the titania nanotubes, and nanopore arrays were obtained through electrodeposition outside the tubes.”

nanotube composite by controlling the polymeric phase. This opens the door for development of light-harvesting systems.

Anodic aluminium oxide is often used as a template for growing one-dimensional nanowires and nanotubes. They created nanowires through electrodeposition inside the titania nanotubes, and nanopore arrays were obtained through electrodeposition outside the tubes. Furthermore,

the nanopore structure exhibited improved mechanical properties compared to anodic aluminium oxide nanowires. A lack of agglomeration of the polymer structure and subsequent collapse was seen in the nanopore structure.

The vertically aligned semiconductor and ultraviolet-sensitive nanostructures developed by NANOICP should open the door to novel applications in a variety of fields. Among the expected beneficiaries are the electronics, photonics and solar energy fields.

NANOICP

- ★ Coordinated by Friedrich-Alexander Universität Erlangen-Nürnberg in Germany.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/project/rcn/93128_en.html

ECO-FRIENDLY, LONG-SHELF-LIFE PACKAGING



EU-funded scientists have advanced new biodegradable packaging for fresh fruit and vegetables that improves their shelf life.

Fresh cut fruit and vegetables is a rapidly growing market because it offers greater convenience while still offering a healthy option. However, the packaging of these products is currently not biodegradable and this increases

the environmental footprint as well as the overall cost of the produce.

The PLA4FOOD (Active Multilayer Packaging based on Optimized PLA formulations for Minimally Processed Vegetables and Fruits) project addressed this by developing ‘polylactic acid’ (PLA)-based packaging that incorporates additives to improve the shelf life of packaged produce. PLA is a biodegradable, thermoplastic material with functional properties similar to fossil fuel-derived plastics.

“PLA4FOOD tested oligomeric lactic acid plasticisers and found one that could significantly improve PLA flexibility.”

Researchers evaluated several natural additives, settling on ‘propane thion-sulphate’ (PTSO, derived from garlic) as a broad-spectrum antimicrobial agent. They also pioneered and successfully tested a microcapsule-based, slow-release system for PTSO that would extend its activity.

Furthermore, PLA4FOOD tested oligomeric lactic acid plasticisers and found one that could significantly improve PLA flexibility. Researchers also found additives to make PLA less permeable in terms of water vapour, an outcome that effectively extends shelf life.

Finally, PLA4FOOD produced two different packaging products: a rigid tray, and a flexible bag or covering material. The products were 100% biodegraded after six months in normal composting conditions.

PLA4FOOD

- ★ Coordinated by the Asociación de Investigación de Materiales Plásticos y Conexas — Aimplas in Spain.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/150838_en.html

FOOD AND AGRICULTURE

INNOVATIVE TECHNIQUES RAISE HOPE OF REDUCING LOSSES FROM CASSAVA AND YAM CROPS

With the likes of climate change, food safety and price volatility particularly affecting them, vital food crops such as root and tuber in developing countries deserve special attention. The GRATITUDE project is focusing on these products with a view to reducing both economic and physical losses from harvesting through to processing.

Cassava (also known as tapioca) and yam may not be very common ingredients in Europe — although yam has become more prominent lately — however some 700 million people depend heavily on these products to feed themselves. Cassava is the third most important source of calories in the tropics according to the Food and Agriculture Organisation (FAO), while yam can be stored for four to six months without refrigeration, making it crucial to the poorest countries in the world. Moreover, these products are key to increasing the resilience of farmers in the face of climate change, drought and fluctuations in the price of durable commodities.

However, cassava and yam production is not without its problems. Physical losses after harvesting and during processing can be as high as 12% and 60% of the yields respectively. Discounting and the need

to process into low-value products also generate serious economic losses. This is particularly true for cassava, as its short shelf life (two to three days) can push resellers to discount fresh root by as much as 85% within a couple of days. Finally, waste such as peeling losses can be high. These peels are largely unused by factories, adding to their operating costs through the need to dispose of them. In several cases, there is no economic value in using waste generated by processing. What's more, this can actually make the processing itself a marginal or non-viable business option.

Advancing state-of-the-art

'Any advances in research and development in tropical root and tuber crops that can reduce losses or even turn losses into gains can have a major, direct impact on improving food security, income

generation and commercial development in the developing world. This in turn would lead to improvement in the social and economic livelihoods of hundreds of millions of poor people,' stresses Prof. Keith Tomlins from the University of Greenwich, coordinator of the EU-funded GRATITUDE (Gains from Losses of Root and Tuber Crops) project.

"The remaining steps are to complete the training in food safety and mushroom production, business plans and an evaluation of new drying technologies for cassava and yam flour production."

Making such advances was the core objective of GRATITUDE, which ends in March 2015. Over three years, the team has conducted an audit on losses in cassava value chains in Vietnam, Thailand, Nigeria and Ghana — a first for this kind of research — and found the losses to be lower than previously thought but the economic impact much higher than expected, particularly in Ghana. They have explored new and innovative uses of 'High quality cassava flour' (HQCF) in Asia and Africa, investigated whether mushrooms could be grown in cassava waste in an economically viable way and investigated whether alternative methods could be developed to recover starch from cassava pulp waste.

'We are on track to achieve all of the objectives,' Tomlins says. 'Our discoveries may direct future government policy

in Ghana where the economic losses from cassava are particularly high (EUR 0.4 billion). We have demonstrated innovative uses of HQCF to access the gluten-free market in various countries and successfully tested it at the consumer level in Vietnam, where it was found to be a viable option for bread making.' Other valuable findings include a mixture of cassava peels and stems that provides a similar but less energy-demanding and faster growing mushroom yield compared to traditional sawdust, along with alternative methods for recovering starch from cassava pulp waste in Thailand using enzymes. Business plans have already been developed for some of these opportunities.

What's next

'The remaining steps are to complete the training in food safety and mushroom production, business plans and an evaluation of new drying technologies for cassava and yam flour production,' Tomlins says. The team expects its findings to start benefitting businesses and households as soon as this year.

GRATITUDE

- ★ Coordinated by the University of Greenwich in the United Kingdom.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/project/rcn/101756_en.html
- ★  <http://bit.ly/1Dx8Nfr>

RESEARCHERS DEVELOP TOOLS TO PROMOTE NOVEL FOOD POTENTIAL

EU-funded researchers have developed a toolbox to improve communication and increase the success rate of novel food technologies in Europe.

A toolbox designed to help food businesses communicate the benefits of their innovations to stakeholders and consumers alike has been developed by EU-funded researchers. The toolkit is based on the findings of the EU-funded CONNECT4ACTION (Strategies for improving communication between social and consumer scientists, food technology developers and consumers) project, which since 2011 has tried to find new ways of promoting the benefits of novel food.

The toolbox consists of seven modules — available on the project website — plus a discussion forum. The tools include a set of recommendations, which summarise the outcomes of all the work undertaken and have been tailored for the various stages of novel technology and product development.

The online kit also includes a set of training modules targeted at young

academics and industry professionals along with concrete examples of communication strategies used by food companies during the innovation process. There is also a glossary of definitions, which has been established to foster shared understanding between different disciplines of frequently used terms.

Taken together, these tools aim to guide food companies towards producing a technology- or product-specific communication plan. By improving communication techniques, higher levels of commercialisation can be achieved, providing an important boost to the food sector.

This is an important issue. Between 70 and 80% of new food innovations introduced in Europe currently fail. This represents not only wasted investment — especially critical at a time of ongoing economic difficulty — but also a

missed opportunity for developing new solutions to tackle pressing health and environmental issues. It also means that Europe is losing out in a globally competitive environment.

"Taken together, these tools aim to guide food companies towards producing a technology- or product-specific communication plan."

The CONNECT4ACTION project, which has received nearly EUR 1 million in EU funding, began by trying to gain a better understanding of the needs and preferences of consumers, in order to better reflect these in the development and commercialisation of new food technologies. Researchers also sought to identify barriers to consumer



acceptance of novel food technologies, and undertook two comprehensive reviews of existing literature on the subject.

The first review focused on internal communication (between different departments such as R&D and

marketing) while the second looked at external communication (targeted at end consumers and the public, but also other stakeholders such as retailers and policy makers). By analysing existing communication strategies and conducting interviews and workshops with

experts, the project was able to develop the recently published set of tools and training materials designed to improve communication.

CONNECT4ACTION researchers also developed a web-based platform to bring together food scientists and technologists from companies, universities and research institutes along with consumer scientists, journalists and consumers. This online community has helped to strengthen the project with input and feedback during various stages. This has also served as a show-case for improved communication.

The project was scheduled for completion at the end of November 2014.

CONNECT4ACTION

- ★ Coordinated by Stichting Dienst Landbouwkundig Onderzoek in the Netherlands.
- ★ Funded under FP7-KBBE.
- ★ http://cordis.europa.eu/news/rcn/122115_en.html
- ★ Project website: <http://www.connect4action.eu>
- ★ <http://bit.ly/1Ff07Pk>

LARGEST WHEAT CHROMOSOME SEQUENCED

A recent bioinformatics project has fully sequenced, characterised and studied the largest wheat chromosome known as chromosome 3B.

Wheat (*Triticum* spp.) is one of the world's most important crops, but the size and complexity of the wheat genome has limited progress in sequencing and characterisation. Recent studies have suggested that gene duplications and rearrangements are unusually common in wheat compared to other crop plants.

The EU-funded NONCOLLINEARGENES (Origin, fate and function of wheat genes noncollinear with the other cereal genomes) project aimed to use the reference sequence of chromosome 3B produced by the French ANR funded project 3BSEQ to better understand the role of duplications in the evolution of the wheat genome.

“They found a high rate of non-synteny in chromosome 3B, suggesting that wheat evolution has recently accelerated.”

(sorghum wheat). In particular, the project investigated non-collinear, or non-syntenic, genes — these are functional groups of genes that are found in dispersed locations on the chromosome and result from intense duplication activities.

Bioinformatics tools were used to compare chromosome 3B in wheat to that of *Oryza sativa* (rice), *Brachypodium distachyon* (a grass) and *Sorghum bicolor*

They found a high rate of non-synteny in chromosome 3B (38%, compared to 5% for the other species), suggesting that wheat evolution has recently accelerated. These were particularly common on the outer edges of the chromosome.



The results also indicate that non-syntenic genes provide functional diversity and a potential for adaptation.

Gene duplication was also confirmed to be unusually common on chromosome 3B. Wheat showed double the rate of intrachromosomal duplication compared to the other species, and 82% of these events occurred in the last 40 million years.

NONCOLLINEARGENES confirmed that wheat has undergone rapid evolution in its recent history and provided new insight into the functional impact of duplications. The

knowledge gained contributes significantly to the growing understanding of the complex genetics of wheat.

NONCOLLINEARGENES

- ★ Coordinated by the Institut National de la Recherche Agronomique in France.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/150920_en.html

SEAWEED EXTRACTS TO PROMOTE WELLNESS

A European project has focused an investigation on the health-promoting activity of a 'Seaweed polyphenol extract' (SPE). After a human intervention study revealed the beneficial impact of seaweed polyphenols on health, the project prepared industry-grade extracts for commercial use.

Accumulating evidence suggests that modern diet and city environments damage biological macromolecules and may lead to a variety of degenerative disorders. Epidemiological studies have shown that a diet rich in fruits and vegetables, red wine and cocoa protects against such damage. The antioxidant and anti-inflammatory properties of this food and drink have been attributed to their high content of polyphenols.

Although polyphenols from land plants are widely used as functional food ingredients and food supplements, seaweed sources have not been exploited. The main objective of the EU-funded SWAFAX (Seaweed derived anti-inflammatory agents and antioxidants) project was to explore methods for extracting polyphenols from the seaweed *Ascophyllum nodosum*. The goal was to derive bioactive compounds from seaweeds for application in food, health and wellness products.

Optimisation of the extraction methods led to a food-grade SPE containing a mixture of different molecular weight polyphenols. When tested on lymphocytes *in vitro*, this SPE exhibited substantial bioactivity and protected cells against DNA damage. It also demonstrated anti-inflammatory activity by reducing pro-inflammatory and increasing anti-inflammatory cytokines.

A human intervention study was conducted and entailed healthy volunteers consuming one SPE. After an eight-week period, participants showed reduced levels of oxidants in



their blood plasma and lower levels of DNA damage. Despite the inter-individual variation in absorption and metabolism of the polyphenols, there was an overall beneficial effect which could be translated into preventive measures against many degenerative diseases.

Exploitation of the SWAFAX SPE project could find a number of commercial applications with significant financial benefit for the SMEs involved. Strong international interest was expressed by various other companies active in the personal care, health supplements and food and beverage markets.

“Optimisation of the extraction methods led to a food-grade SPE containing a mixture of different molecular weight polyphenols.”

SWAFAX

- ★ Coordinated by the University of Reading in the United Kingdom.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/result/rcn/150845_en.html
- ★ Project website: <http://www.cybercolloids.net/swafax-project>

EVENTS

FEBRUARY
25 ▶ 26

Brussels, Belgium

FORUM

THIRD EUROPEAN ELECTROMOBILITY STAKEHOLDER FORUM

The EU's three flagship electromobility projects will present their findings and plans on electromobility in Europe, covering topics such as smart technology, standardisation, electric urban freight and the benefits of electric vehicles to society and the environment. With Green eMotion drawing to a close, attendees will also have an opportunity to hear their final results and project conclusions.

The forum will be a mixture of parallel workshop sessions and high level round tables with participation from EU, national and regional political stakeholders as well as industry and research institutes. There are three parallel workshop sessions throughout the event and you are asked to register in advance for which session you wish to attend.

For further information, please visit:
<http://www.eventbrite.co.uk/e/european-electromobility-stakeholder-forum-registration-12599167449>

MARCH
10 ▶ 13

Bilbao, SPAIN

EVENT

IMAGINENANO 2015

The third edition of ImagineNANO, the largest European event on nanoscience and nanotechnology, will take place from 10 to 13 March 2015 in Bilbao, Spain.

The event will encompass six conferences covering hot science trends. The main focus will be on nanoscience and nanotechnology in the fields of graphene, (bio)medicine, optics, photonics, chemistry and toxicology. Internationally renowned speakers will provide attendees with an opportunity to identify the latest trends and discoveries in N&N from some of the world's leading players in the field.

ImagineNano will gather the global nanotechnology community together, including researchers, industry policymakers and investors. It will include an exhibition with already 20 institutions having registered their booth.

For further information, please visit:
<http://www.imagenano.com/GENERAL/index.php>

MARCH
11 ▶ 15

Sofia, BULGARIA

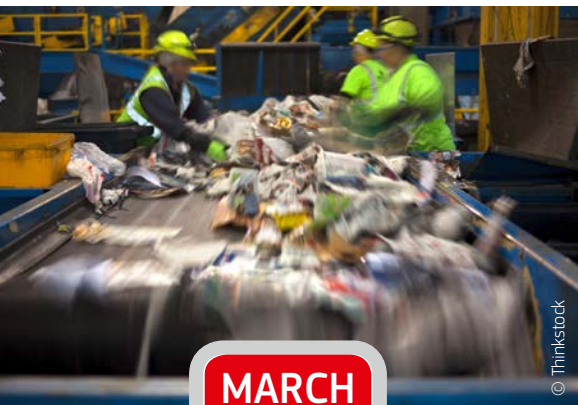
CONFERENCE

11TH SOUTH-EAST EUROPEAN CONFERENCE AND EXHIBITION ON ENERGY EFFICIENCY AND RENEWABLE ENERGY

The 11th South-East European Conference and Exhibition on Energy Efficiency and Renewable Energy will take place from 11 to 15 March 2015 in Sofia, Bulgaria.

South-East Europe plays a key role in the achievement of the EU targets 20-20-20, and has a high potential in terms of growth for the renewable energy market. The 2015 edition of this event will promote the latest energy-related advances and encourage their large-scale implementation in South-East Europe as well as speeding up foreign investment in the regional economy. It is a great networking place for international and local industry players.

For further information, please visit:
<http://viaexpo.com/en/pages/ee-re-congress>



MARCH
11 ▶ 13

Sofia, Bulgaria.

CONFERENCE

SAVE THE PLANET: WASTE MANAGEMENT AND RECYCLING CONFERENCE

The 'Save the Planet' conference on waste management and recycling will take place from 11 to 13 March 2015 in Sofia, Bulgaria.

The conference will present case studies on waste management and will provide a closer look at the market potential in South-East Europe (SEE) that could be realised through new financing and incentive schemes. Paper topics will cover: waste administration; how to prepare a good waste reduction plan; waste collection & separation; resource efficiency & recycling and strategies for construction waste recycling and composting.

The conference sessions will explore existing legislation and good examples. Sessions will include: 'Towards a Circular Economy — in cooperation with ENEP'; 'Recycling of Construction & Demolition Waste (C&DW) — in cooperation with EDA'; and 'Plastic Waste Recycling'.

For further information, please visit:
<http://viaexpo.com/en/pages/waste-management-recycling-conference>

EVENTS

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

MARCH
15 ▶ 19

Krakow, POLAND

CONFERENCE

SECOND INTERDISCIPLINARY SCIENTIFIC CONFERENCE

The Second Interdisciplinary Scientific Conference 'Mathematical Transgressions' will take place from 15 to 19 March 2015 in Krakow, Poland.

Conference topics will include, among other things: the didactics, psychology and philosophy of mathematics; the relationship between theory and practice in mathematics education; and underachievement syndrome in learning mathematics. Educators of mathematics, mathematicians, pedagogues, psychologists and philosophers are invited to participate. Activities will include plenary lectures, oral presentations, workshops and an 'open discussion'.

The conference will be conducted in English and Polish, however one of the plenary lectures will be given in French. Simultaneous translation will be provided for plenary lectures and workshops. Regular registration fees apply until 31 December, after which late registration fees will apply.

For further information, please visit:
<http://ikntm.up.krakow.pl/II/index.php?&ac=en>

MARCH
19 ▶ 20

Florence, ITALY

CONFERENCE

SECOND INTERNATIONAL CONFERENCE ON FOOD SECURITY AND NUTRITION (ICFSN 2015)

The Second International Conference on Food Security and Nutrition (ICFSN 2015) will take place from 19 to 20 March 2015 in Florence, Italy.

The aim of the conference is to provide a platform for researchers, engineers, academics as well as industrial professionals from all over the world to present their research results and development activities in food security and nutrition.

Submitted conference papers will be reviewed by the technical committees of the Conference. The registration fee for authors ranges from EUR 360 to EUR 440.

For further information, please visit:
<http://www.icfsn.org/>

MARCH
20 ▶ 21

FLORENCE, ITALY

CONFERENCE

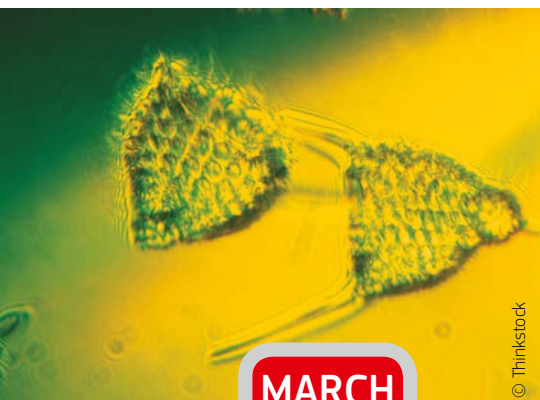
FOURTH EDITION OF THE INTERNATIONAL CONFERENCE NEW PERSPECTIVES IN SCIENCE EDUCATION

The Fourth Edition of the International Conference New Perspectives in Science Education will be held from 20 to 21 March 2015 in Florence, Italy.

The conference gives academics, researchers, teachers, experts and practitioners from all over the world the chance to share innovative ideas, experiences, research findings and best practice in the field of science education. While the participants will be international, the conference is also intended as a venue to present the results of projects funded by the European Commission in the field of science education.

Anyone wishing to submit an abstract can send it to the organisers by email before 1 December 2014. Registration by 12 January is EUR 250 and findings will be published in hard copy format in the form of a book called, 'New Perspectives in Science Education, Conference Proceedings 2015', on a CD-Rom to be distributed to all attendees and on the conference website.

For further information, please visit:
<http://conference.pixel-online.net/NPSE/index.php>



© Thinkstock

MARCH
22 ▶ 26

Antalya, Turkey.

CONFERENCE

14TH INTERNATIONAL CONFERENCE ON FOSSIL AND RECENT RADIOLARIANS (INTERRAD)

The 14th International Conference on Fossil and Recent Radiolarians (INTERRAD) will take place from 22 to 26 March in Antalya, Turkey.

The conference will comprise a series of scientific sessions including plenary and special sessions, in addition to pre-, mid- and post-conference field excursions. Well-exposed radiolarian-bearing successions in central, western and southern Turkey in addition to some archaeological sites can be visited during these field excursions.

Early registration fees (before 15 January 2015) range from EUR 290 to EUR 470.

For further information, please visit:
<http://interrad2015.org/>

Twenty years for CORDIS on the World Wide Web



In November 2014, **CORDIS** celebrated its 20th World Wide Web Birthday. Indeed, it was on 7 November 1994 that the www.cordis.lu domain was registered, leading to the launch of the EU institutions' first permanent website.

While the CORDIS web server was initially used for the partner search service, expressions of interest and the first calls for proposals of the 4th research Framework Programme (FP4), it quickly became clear that the web was not just an additional technology. The early 2000s saw CORDIS become the central web platform of the research and innovation programmes, hosting thousands of web pages for each programme and developing web applications for a variety of needs.

Now CORDIS contains information on over 100 000 EU-funded projects, stretching from some of the earliest EU research under the 1st Framework Programme (FP1) through to the planned publication of emerging Horizon 2020 projects. The core information on projects and results is complemented by multilingual top stories and news services, including articles submitted by the research community. These and highlights of project 'Results in Brief' are included in this magazine.

After 20 years on the web, we are again experiencing a shift, as the number of website visitors is less of a measure of success than making it easy for clients to find and reuse our rich repository of data. After the launch of the new suite of web applications, the future of CORDIS will be driven in the years to come by the European Commission's strategy for the dissemination and exploitation of research results.

Free subscriptions, orders and downloads



The *research*eu* magazines are free of charge.

To subscribe to either *research*eu results magazine* or *research*eu focus*, please go to:
<http://cordis.europa.eu/research-eu>

To order a single issue of a *research*eu results magazine*, please go to:
http://bookshop.europa.eu/research_eu



For an issue of *research*eu focus magazine*, please go to:
http://bookshop.europa.eu/research_eu_focus



Publications Office
 ■ eur-lex.europa.eu • EU law
 ■ bookshop.europa.eu • EU publications
 ■ ted.europa.eu • Public procurement
 ■ cordis.europa.eu • Research and development



Follow us on Facebook and Twitter:
facebook.com/EULawandPublications
twitter.com/myCORDIS
twitter.com/CORDISfunding