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In this issue:

 Special feature:

Africa: international cooperation,
research for development and the digital divide. ■

Interview: Graciela M. Rusch of the Norwegian Institute for Nature
Research (NINA) — on trees and sustainable agriculture in Africa ■

Other highlights:

New nomenclature for *Biomphalaria* species in Lake Victoria, page 6 ■

Sounding out bubbles in pipes, page 13 ■

Europe, South Africa look to water conservation, page 24 ■

Inspired by challenge — our robotic future, page 31 ■

Europeans push the bio-nano-technology envelope, page 39 ■



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Cooperation is key: from development to research

On 24 October, United Nations Day coincides with World Development Information Day, established in 1972 to draw the world's attention to the problems of global development and the international cooperation efforts to solve them. Research is just one of the forms of international cooperation that can improve the lives of people with poor access to land, water and resources, but it is an important one. African science is also moving from strength to strength, with many research organisations interested in collaboration with European ones.

So cooperation with countries outside the EU has always been an important part of the EU's research Framework Programmes (FPs). FP7 includes a budget line on 'International cooperation' to support international science and technology policy dialogue and coordination, under the specific programme 'Capacities'. Researchers and organisations from outside the EU can also participate in projects funded under the specific programme 'Cooperation', and receive funding if they are from recognised 'International cooperation partner countries' (ICPCs) — as most African countries are.

In 2009, a EUR 63-million FP7 call was dedicated wholly to research with Africa, addressing some of the science and technology objectives included in the 'EU-Africa Strategic Partnership'. The funded projects aimed to strengthen Africa's research base, as well as improve health conditions and water and food security.

And previously, under FP6, many European research projects worked fruitfully in Africa and with African organisations. With this in mind, the special feature in this issue of *research*eu results magazine* focuses on 'Africa: international cooperation, research for development and the digital divide'.

The 'environment and society' section features many examples of research for development and research in Africa, starting on page 22 with 'How trees can help poor farmers'. This is an interview with Graciela M. Rusch, Senior Research Scientist at the Norwegian Institute for Nature Research (NINA) and coordinator of the Funtree project, which is studying 'Agro-forestry systems' and the factors affecting or preventing their adoption in two sub-Saharan sites, in Mali and Senegal.

The 'biology and medicine' section also starts with an article on research relevant to development in Africa. 'New nomenclature for *Biomphalaria* species in Lake Victoria?', on page 6, reports on a project that investigated the water snails in Africa's Lake Victoria that act as an intermediate host for the human parasite responsible for *schistosomiasis*. Understanding the types of snail species present in the lake may help prevent the spread of this disease.

The 'energy and transport' section starts with the article 'Sounding out bubbles in pipes' on page 13. The story focuses on how European researchers helped find a new method of measuring gas bubbles in pipelines, enabling workers to avoid bubble 'blow-outs' like the one that took place in the Gulf of Mexico in 2010.

The feature article of the 'IT and telecommunications' section is 'Inspired by challenge — our robotic future' on page 31, which looks at how European scientists are developing robots by looking at the problems we face today and the challenges of the future, then trying to build smart and intelligent technologies to combat these difficulties.

The 'industrial technologies' section opens with 'Europeans push the bio-nano-technology envelope', on page 39, which shines the spotlight on a project using so-called 'DNA origami' to build nanopore biotechnology — one of the most promising approaches to single molecule detection and analysis.

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

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

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Watch this space!

Coming up in issue 16 of *research*eu results magazine* — a special dossier on 'Natural disasters and climate change: how science expects the unexpected'.

TABLE OF CONTENTS

BIOLOGY AND MEDICINE	6
New nomenclature for <i>Biomphalaria</i> species in Lake Victoria?	6
Researchers develop novel method for silk thread unravelling	7
Cutting mosquito lifespan to control malaria	7
Nanotechnology for targeted cancer therapy	8
Hindering infection with sugars	9
Laser-ing in on brain surgery	9
Tiny robots for less-invasive surgery	10
Better quality meat	11
Improved gel matrices for tissue regeneration	12
Harnessing fungal-plant relationships for greener cultivation	12
ENERGY AND TRANSPORT	13
Sounding out bubbles in pipes	13
Smart ICT for energy efficiency	14
Renewable energy in the form of oil from algae	16
Automatic temperature regulation without energy input	16
Superconducting cables for electricity grids	17
Mimicking plants for clean, renewable energy	18
Automated high-voltage transformer-monitoring system	18
Exploiting the offshore sector	19
Intelligent cargo for more efficient, greener logistics	20
The road to heavy-duty fuel cells	21
ENVIRONMENT AND SOCIETY	22
How trees can help poor farmers	22
Europe, South Africa look to water conservation	24
Advancing Africa's right to clean water	24
Enhancing African smallholder farming productivity	25
Restoring woodlands in Tanzania	26
New farms for new fish	26
Managing vegetation from space	27
Sharing water fairly for mutual benefit	28
Traditional cereal improves quality of life	28
Supporting innovative agriculture in water-dry areas	29
Improved resource management for better ecosystems	30

TABLE OF CONTENTS

IT AND TELECOMMUNICATIONS	31
Inspired by challenge — our robotic future.....	31
One step closer to quantum computers.....	32
P2P comes to the rescue of Internet video.....	33
Software development gets easier	34
New optical sensor can ‘see’ dangerous chemicals	35
Shedding light on experimental physics	36
Communicate with the future.....	37
Stimulating communication, preventing selfish behaviour	38
INDUSTRIAL TECHNOLOGIES	39
Europeans push the bio-nano-technology envelope.....	39
Enhanced efficiency of nickel mining.....	40
Enhancing quality control in aeronautics	41
Rational design of stretched plastic packaging.....	41
Multi-functional decorative coatings for electronics.....	42
Using nature’s cue to make complex natural products	42
Magnetic refrigerators	43
Environmentally friendly catalyst for industrial use.....	44
Novel ceramic materials and processes	44
The manufacturing miracle.....	45
EVENTS	46

BIOLOGY AND MEDICINE



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New nomenclature for *Biomphalaria* species in Lake Victoria?

Africa's Lake Victoria is a hot spot for Schistosoma mansoni, a major human parasite responsible for schistosomiasis (snail fever) that uses freshwater snails of the genus Biomphalaria as intermediate hosts. Past studies linked some Biomphalaria species with varying parasite compatibility, which impacts local transmission. Now researchers from the United Kingdom have discovered that molecular groupings are inconsistent with morphological divisions, suggesting that the various forms of the snail are in fact a single species.

The study, published in the journal *PLoS ONE*, was funded in part by the Contrast¹ project. Contrast received almost EUR 3 million in funding under the International Cooperation (INCO) Cross-cutting activity of the EU's Sixth Framework Programme (FP6).

Putting morphological and molecular variables in the spotlight, researchers found that molecular groupings are inconsistent with morphological divisions.

Their data show that habitat predicted morphotype, or in other words the shape of the snail is correlated with where they live, thus hinting that the various forms of *Biomphalaria* found in Lake Victoria are 'ecophenotypes' of one species — that is, they are phenotypes resulting from environmental conditions and not from different genetic make-up.

The researchers recommend a change be made to the classification, proposing the

names *B. choanomphala choanomphala* and *B. c. sudanica*.

'The desire to identify accurately the species of *Biomphalaria* in Lake Victoria is linked directly to the need for greater understanding of the transmission patterns of *S. mansoni* in the lake,' write the authors of the paper. 'Intestinal *schistosomiasis* is rife in communities living by the lakeshore, and by understanding the dynamics of the snails responsible for transmission it will be possible to identify possible exposure hot spots, and direct treatment and education interventions to these areas.'

The team says an interesting finding was that several differences in the average measurements were significant between habitat types. 'Although causation is far from certain, this evidence could tentatively suggest that habitat might be a factor in driving the morphological plasticity seen in the dataset,' the authors write. 'Shell shape is known to be strongly environmentally determined in many

snail species so it would not be difficult to imagine factors associated with habitat driving ecophenotypic variation in *Biomphalaria* in Lake Victoria.'

Policy-makers could use the results of this study to improve our knowledge of exposure risk, and devise and implement better and more effective initiatives for disease control.

This study was undertaken by researchers from the University of Nottingham, and the Natural History Museum, London, in the United Kingdom.

1 'A multidisciplinary alliance to optimise *schistosomiasis* control and transmission surveillance in sub-Saharan Africa'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'. Promoted through the Research Information Centre. <http://ec.europa.eu/research/infocentre> > search > 23335



Researchers develop novel method for silk thread unravelling

Scientists led by Oxford University in the United Kingdom have discovered that a layer of mineral calcium oxalate covers the surfaces of wild cocoons, making unravelling a complex process. Removal of this layer facilitates the unreeling of silkworm cocoons into long strands of silk comparable to those derived from the domesticated mulberry silkworm (*Bombyx mori*, *B. mori*).



©F.Vollrath/OxfordSilkGroup

The research was funded in part by the SABIP¹ project, which has clinched a European Research Council (ERC) grant worth almost EUR 2.3 million under the EU's Seventh Framework Programme (FP7). Presented in the journal *Biomacromolecules*, the findings could lead to the development of new silk industries in Asia, Africa and South America, areas where wild silkworm numbers are in abundance.

People have long recognised how crucial a role silk moths play in the silk industry. Silk fabric first materialised in ancient China, as long ago as 3500 BCE. Made by the unravelling of fine, soft thread from the silk moth's cocoons, the majority of silk found in today's markets comes from cocoons of

B. mori. Unravelling (unreeling) the threads from this silkworm is easy, allowing long continuous strands to emerge.

For those working in the silk industry, unravelling the cocoon threads of 'wild' species is not as easy. In order to get the product they want, workers use harsher methods on the cocoons. The drawback, however, is that the strands are usually damaged, resulting in poorer quality silk. Enter the Oxford team, which successfully developed and tested a method to unravel the strands of silk of wild cocoons without damaging them.

They tested their new method on the wild silkworm *Gonometa postica*. Using a warm solution of 'Ethylenediaminetetraacetic acid'

(EDTA), the team softened the cocoons sufficiently to unravel the farmed silk without damaging the threads.

By 'demineralising' the surfaces of wild cocoons — i.e. removing the mineral calcium oxalate layer — the researchers were able to unreel the cocoons into long continuous strands with commercial reeling equipment. These strands could easily compete against those of the Mulberry silkworm cocoons.

'Unlike traditional ways of treating wild silk cocoons — such as degumming using pineapple juice, carding and hand spinning — our new method softens the cocoon so that it can be reeled but does not damage the strands which give silk its sought-after properties,' explains Tom Gheysens from the Department of Zoology at Oxford University, who led the work with Oxford supervisor Professor Fritz Vollrath. 'The demineralising process makes it possible, for the first time, to create long continuous strands of silk from wild cocoons producing a high-quality wild silk which

is, potentially, a match for the "farmed" variety.'

Writing in the paper, the researchers conclude: 'The fibres of *G. postica*, which previously had not been examined in any great detail, when obtained this way showed competitive properties to fibres produced by the commercial mulberry silkworm *B. mori*. This suggests that our degumming method should increase the range of wild silk moth species that can be wet reeled, and may be important for the development of the silk industries not only in Asia but also in Africa and South America.'

The study was led by scientists from Oxford University, in the United Kingdom, with contributions from the University of Bristol, United Kingdom, and the Commercial Insects Program, International Centre of Insect Physiology and Ecology in Kenya.

1 'Silks as biomimetic ideals for polymers'.

Funded by the European Research Council (ERC) under the FP7 specific programme 'Ideas'.
<http://erc.europa.eu/success-stories/new-polymers-strong-silk>
 Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre/search/21553>



Cutting mosquito lifespan to control malaria

EU research has developed a promising new strategy for the control of malaria. Infecting the female mosquito with a bacterium, to cut her lifespan, will help prevent the spread of the parasite.



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The high incidence of malaria in Africa — due to its vector, *Anopheles gambiae* (*A. gambiae*) — needs to be tackled by novel control strategies. One possible approach is to reduce the mean age reached by adult female mosquitoes. This significantly limits the spread of malaria due to the lengthy incubation period of *Plasmodium* parasite prior to its transmission.

A strain of bacterium *Wolbachia* called *wMelPop* has recently been shown to shorten the lifespan of mosquitoes other than *A. gambiae*.

The EU-funded Anopage¹ project has been examining the potential of *wMelPop* as a novel malaria-control tool in *A. gambiae*.

Anopheles cell lines infected by *wMelPop* were created, characterised, purified and transferred into *A. gambiae* by microinjection. The effect >

BIOLOGY AND MEDICINE

on parasite inhibition and mosquitos' lifespan was then monitored.

Anopage researchers used state-of-the-art techniques, including quantitative 'Polymerase chain reaction' (PCR), fluorescence microscopy, complementary DNA (cDNA) microarrays and gene knockdowns. Injecting purified *wMelPop* cells into adult females created non-inherited somatic infections. Creation of stable inherited infection is in progress.

An age-estimation assay for the *A. gambiae* complex was developed and tested under semi-field conditions to compare age structure between greenhouse and wild populations. A suite of mathematical models analysed different interventions affecting adult mosquito longevity.

Project data revealed a significant up-regulation of several immune genes in the infected mosquitos, along with a direct inhibition of *Plasmodium* parasites.

In addition, seasonal and highly male-biased releases were found to be essential for successful *Wolbachia* spread and reduction of vector capacity.

The knowledge and the experimental tools produced by the Anopage project are pushing the frontiers of malaria research. The design and application of more effective strategies to control malaria spread can now be initiated.

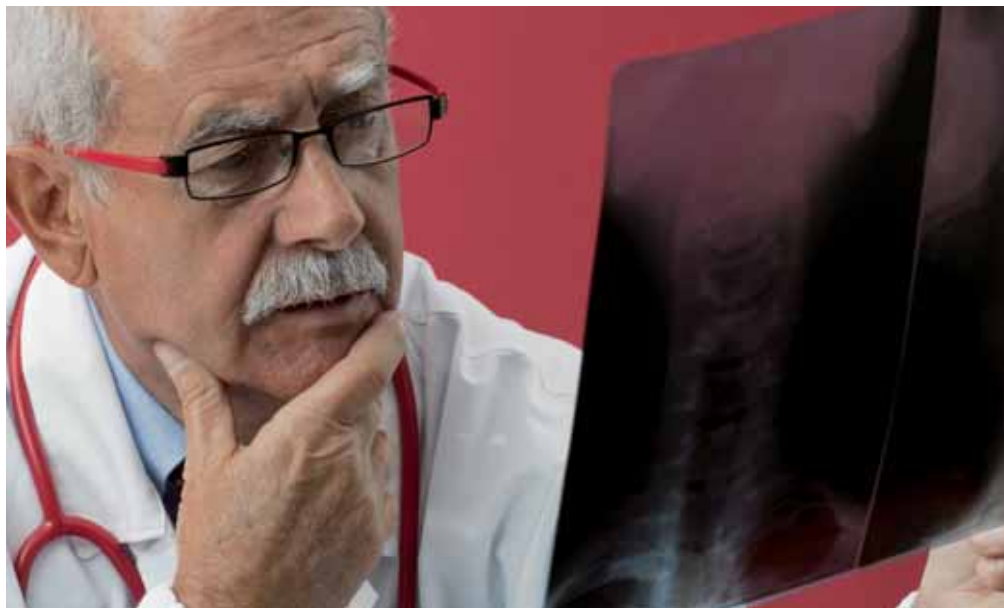
The project was coordinated by researchers at the University of Oxford, United Kingdom.

1 'Population age structure and age structure modification via *Wolbachia* in *A. gambiae*'.

Funded under the FP7 specific programme 'Health'.
<http://cordis.europa.eu/marketplace/search/offers/8875>

Nanotechnology for targeted cancer therapy

EU-funded researchers have made new advances in the use of functionalised nano-materials with photosensitive capabilities — having potential applications in areas as diverse as drug delivery and energy conversion.



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Nanoparticle-based drug-delivery systems are likely to reduce toxicity and side effects (via targeted delivery), cost of treatments and even time of treatment with respect to alternative therapies.

'Single-walled carbon nanotubes' (SWNTs) have received much attention lately due to the discovery that they can potentially penetrate human cells four times faster and travel deeper than comparable uniformly shaped particles. For example, rapid local injections of drugs could take the place of several hours of

non-localised intravenous infusion in diseases like rheumatoid arthritis or Crohn's disease.

Combining SWNTs with those smart materials that respond to environmental stimuli, to create controllable drug-delivery devices for tumour therapy, was the driving factor behind the SNAP¹ project.

Scientists focused on photosensitisers, substances that react to the absorption of light. One class of these substances is used in photo-dynamic cancer therapy, whereby exposure to light

activates a drug that kills cells. While highly effective, they lack specificity with respect to healthy and cancerous cells and are not very soluble in water, the basis of intra- and extra-cellular fluid.

In order to enhance their ability to differentiate between normal and cancerous cells, researchers sought to functionalise photosensitisers. Addition of various sensor (receptor) units would enable the photosensitisers to be switched on or off in the presence or absence of certain signals (substrate molecules that bind with the receptor, or local

environmental conditions such as ion or pH changes).

Researchers developed water-soluble carbon nanotubes and characterised them using a variety of experimental techniques, providing information not found in the literature. They also developed a procedure for producing high-purity selectively functionalised SWNTs that preserved optical and electrical properties.

Synthesis and characterisation of a number of potential photosensitisers, and subsequent covalent bonding to SWNTs, pointed to uses in photovoltaic applications, such as energy conversion.

The SNAP project team made important progress in the development of water-soluble SWNTs and photo-sensitisers that should serve as a basis for further development of targeted and intelligent photo-dynamic drug-delivery systems as well as solar-energy devices.

This project was coordinated by researchers at Trinity College Dublin, Republic of Ireland.

1 'Smart nano-materials with applications in photo-dynamic therapy'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace/search/offers/8909>

Hindering infection with sugars

A team of European researchers is applying glycoscience to the development of revolutionary new drugs and vaccines. Targeting pathogens in the early stages of infection also promises to aid the efficiency of current therapies.



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Glycoscience — the study of the complex carbohydrates on the surface of proteins and lipids — is on the verge of creating a revolution in molecular biology. In particular, glycoproteomics is helping to forge a path for the development of new drug and vaccine therapies.

Biotech experts and academic institutions in the field are working together on the EU-funded

Carmusys¹ project. The consortium is focusing on a membrane protein of immune dendritic cells, DC-SIGN.

This membrane protein is a highly important part of the immune system. It facilitates invasion of certain pathogens, notably HIV. Importantly for control of infection, DC-SIGN action can be blocked by sugars when present in multiple copies on scaffolds — multivalent elements that can react with a number of members of a signalling pathway.

The multidisciplinary Carmusys team worked to analyse and synthesise DC-SIGN ligands and multivalent scaffolds to bind to a variety of receptors. Project scientists also investigated and evaluated the different ligand-receptor interactions. Specifically, the focus is being placed on receptors in genital and intestinal

mucosa, a common entry point for many pathogens.

Project researchers have built up a library of potential DC-SIGN ligands based on carbohydrates and glycomimetics. The team used computational methods as well as 'Nuclear magnetic resonance' (NMR) spectroscopy, X-ray diffraction and biosensors. Evaluating criteria such as affinity, binding mode, the epitope (or portion of the molecule responsible for the binding), four monovalent ligands have been selected for the basis of multivalent systems.

Using the simple sugar, mannose, as a reference ligand, Carmusys has also developed a set of multivalent scaffolds, for future testing using biosensors, to select the most appropriate binding ligand for DC-SIGN. Assays for evaluation of the activity of selected compounds, and tests

including infection and immunological criteria, are available as a result of the project's work.

Promising results from the Carmusys initiative have been published and patents secured. Data indicates that DC-SIGN incorporated into a specially constructed receptor site is a new target for the design of antiviral agents.

The project was coordinated by the Spanish National Research Council — Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC).

1 'Carbohydrate multivalent systems as tools to study pathogen interaction with DC-SIGN'.

Funded under the FP7 specific programme 'People'.
<http://cordis.europa.eu/marketplace/search/offers/8851>

Laser-ing in on brain surgery

Medical operations have become almost commonplace, but the delicacy of medical procedures involving the brain and the spinal cord force physicians and patients to consider other alternatives. European researchers, however, could change this following their development of a laser for minimally invasive brain surgery.

The achievement is the result of an interdisciplinary EU project that involved partners from seven European countries, creating a table-top solid-state laser system that can cut brain tissue with unprecedented precision. These results are an outcome of the Mirsurg¹ project, which secured almost EUR 2.8 million in funding under the 'Information and communications technologies' (ICT) theme of the EU's Seventh Framework Programme (FP7).

The inspiration for the project began in 1999 when scientists

from Vanderbilt University in the United States removed a brain tumour from a patient with a free-electron laser at a wavelength of 6.45 microns (µm). It is important to note that this wavelength — in the mid-infrared spectral region — had been recognised in a number of early experiments, with different soft tissues, as being the most suitable for such surgical operations. Despite this, the technological know-how has not been transferred into operating rooms, as the equipment needed could not fit. ➤



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BIOLOGY AND MEDICINE

Free-electron lasers, for example, are huge and accelerator-based facilities are both expensive and generally unsuitable for routine use in clinical conditions.

In 2008, the Mirsurg project was launched with the objective of developing a laser source that would emit a wavelength near 6.45 μm and provide the high single-pulse energy and average power needed for minimally invasive neurosurgery. The project partners believed such an achievement would close the gap for diode-pumped solid-state lasers in the mid-infrared spectral range around 6.45 μm .

'So far, there were no compact and reliable solid-state lasers emitting at the desired

mid-infrared wavelength,' explains Dr Valentin Petrov from the Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy (MBI), which headed the project.

The Mirsurg team presented a fairly compact all-solid-state prototype that fits on a table-top at a recent meeting in Saint-Louis, France. The desired optical wavelength of 6.45 μm is generated by frequency conversion. A laser beam with a wavelength near 2.0 μm is converted to the mid-infrared by the use of non-linear optical crystals.

The new laser emits short pulses exactly at 6.45 μm with a repetition rate of 100-200 hertz

(Hz) which ensures the targeted average power of over 1 watt. The greatly reduced collateral damage at this wavelength is due to the combined absorption of water and resonant laser heating of non-aqueous components (proteins). The penetration depth at this wavelength is of the order of several microns, which is comparable to the cell size, and is therefore close to the optimum value, not achievable by any other state-of-the-art lasers.

The Mirsurg partners plan to further optimise the new table-top laser, assess its tissue-ablation capabilities and, possibly within a follow-up project, demonstrate real solid-state laser surgery at 6.45 μm . 'I hope that in the near

future such a laser could become a practical surgical tool in every specialised operating room,' says Dr Petrov.

This project was coordinated by the Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy (MBI) in Berlin, Germany.

1 'Mid-infrared solid-state laser systems for minimally invasive surgery.'

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'.
Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 25573

Tiny robots for less-invasive surgery

Millions of Europeans undergo abdominal surgery each year to treat a range of different disorders, from cancer and heart disease to obesity. EU-funded researchers are developing innovative micro-robotics and micro-system technologies to make such operations less complicated, invasive and costly.



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Surgical procedures have improved rapidly in recent years, aided by technology that is gradually making the surgeon's scalpel a thing of the past — increasingly replaced by robotics, miniature devices and innovative procedures that have fewer health risks, speed patient recovery and leave less scarring. But there is always room for further improvement.

'There are issues with abdominal surgery at present, both with the technology and the procedure,' says Professor Arianna Menciassi of the BioRobotics Institute at Scuola Superiore Sant'Anna in Italy.

At present, abdominal surgery is either performed by a surgeon manually, using a key-hole

technique also known as laparoscopy, or with the aid of a tele-operated robotic device. The most widely used surgical robot for the procedure is highly precise — more so than manual surgery — but it is also bulky, expensive and still requires several incisions to be made in the abdomen.

This current system makes the surgery easier for the surgeon, 'but it is just as invasive as the traditional laparoscopic procedure for the patient, requiring a minimum of four incisions in the abdomen: two for the robotic tools, one for further manoeuvres and one for a camera,' Prof. Menciassi explains. 'We set out to develop an alternative system using state-of-the-art micro-robotics and micro-system technologies that would be less expensive and less invasive.'

Working in the Araknes¹ project, Prof. Menciassi and a team of researchers from across Europe focused on an approach to abdominal surgery that integrates the advantages of traditional open surgery, 'Minimally invasive surgery' (MIS) — also known as laparoscopic or key-hole surgery — and robotic surgery. Supported by EUR 8.1 million in funding from the European Commission, the

Araknes team developed highly innovative devices and technologies that greatly reduce the invasiveness of surgical procedures, minimise scarring, decrease the risk of infection, and speed patient recovery time at potentially much lower cost than existing commercial systems.

One of the results of Araknes is a tele-operated robotic system called the 'Single-port laparoscopy bimanual robot' (Sprint) that replicates with high precision the hand movements of a surgeon sitting at a console interface. However, the system is specifically designed for 'Single-port laparoscopy' (SPL) — a relatively new type of keyhole surgery in which the surgeon operates through a single incision, usually in the patient's navel.

'Instead of four incisions, this technique uses only one incision — the access port — of around three centimetres in diameter. And because the incision is made through the navel — a natural scar — there is no visible scarring,' explains Prof. Menciassi, the Araknes scientific manager.

Sprint is comprised of two arms with six degrees of freedom of movement and rotating grippers

at the end, providing a high degree of dexterity for performing a wide variety of surgical tasks inside the patient's body.

'The arms function much like our own and, through the tele-operated interface, replicate precisely the movements of the surgeon, who views the procedure via a 3D high-definition camera,' Prof. Menciassi says.

Crucially, thanks to state-of-the-art micro-robotic technology, the motors that control the grippers and the 'elbows' of each arm are located on the device, while the motors for the 'shoulders' are external.

'This is a key difference with existing commercial systems, as it means the entire system is much less bulky. It fits much more easily into the operating room and allows better access to the patient,' the project manager explains.

The reduced size of the system was one of several highly regarded features by surgeons

who conducted *in-vivo* tests on a pig at a lab run by project partner Novineon in Germany in January.

'Surgeons accustomed to using the previously existing DaVinci system welcomed the small size and increased visibility of the patient, as well as the reduced invasiveness, while surgeons who normally perform the single-port procedure manually saw an immediate advantage in terms of precision,' Prof. Menciassi says.

Another device developed by the Araknes team is designed to eliminate the need for incisions entirely. Developed for 'Natural orifice transluminal endoscopic surgery' (Notes), the device consists of a magnetic platform coupled with miniature robotic arms that can be inserted into the patient through a natural orifice, such as the mouth or anus, with no other incision necessary.

Notes itself is still considered an experimental surgical technique, but one that potentially has many

advantages for the patient over invasive methods.

'The Notes platform is experimental, and unlikely to be used in surgery for some time for both technical and clinical reasons. Nonetheless, it consists of many innovative enabling technologies that could find more immediate applications,' the project manager continues.

On the other hand, the Sprint robotic system is much closer to market in light of the success of the *in-vivo* trials carried out by the project partners. The Sprint technology is currently being patented and the partners are looking to use it as the basis for a commercial system.

'We are currently seeking funding from both public and private sources for further development,' Prof. Menciassi explains. 'It's still a prototype, but we are confident that if produced commercially it would be less expensive than existing systems. Plus the faster recovery time using the SPL

technique should reduce hospitalisation time for the patient, lowering health-care costs.'

The Araknes team initially focused their work on developing systems for weight-loss surgery, a procedure to reduce the size of the stomach, or bypass it entirely, that is undergone by tens of thousands of Europeans each year. However, Prof. Menciassi emphasises that the devices could be used for any type of abdominal surgery — for example, to remove cancerous tumours or treat problems with the heart, liver or kidneys.

This project is coordinated by the BioRobotics Institute at Scuola Superiore Sant'Anna in Italy.

1 'Array of robots augmenting the kinematics of endoluminal surgery.'

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'.
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Better quality meat

A study of the meat supply chain is revealing several novel ways to upgrade quality, promote food safety and reduce risk from microbial diseases.



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The meat industry is an important part of the economy and the food chain, but it has sometimes been mired in controversy and acquired an unhealthy reputation. The EU-funded Quarisma¹ project is bringing innovation and in-depth know-how to the sector, creating progressive exchanges between industry and research. The project is focusing on chain management, quality standards, information management, risk

management and food safety, using boar meat as a starting point.

Quarisma is working on developing and improving cost-effective consumer-oriented net-chain integration, through public-private partnerships and knowledge transfer. It is using the 'Deutsche Raffeisen Verband' (DRV) in Germany as a sustainable model and conducting a study

on planning, logistics and optimisation of meat chains. This is expected to lead to mechanisms that can combat outbreaks of classical swine fever in the Lower Saxony region.

Moreover, the project is looking at herd health management in pork, which includes the application of antibiotics. It is elaborating recommendations to improve animal health and production, strongly supporting farmers and actors in the meat chain.

In more detail, the project has developed a new approach to compare the microbiological quality of minced meat produced in different production plants. It has validated serological screening for *Mycobacterium Avium* and developed a new boar-taint detection method. Quarisma has also improved disinfection of slaughter equipment, studying risks of listeria, salmonella and other disease hazards.

These new innovations and accompanying studies are expected to improve risk-based meat inspection across Europe and support farmers in health management throughout the meat supply chain. The developments will bring a welcome boost to food safety, disinfection methods, environmental management and more.

The project is coordinated by Trans-Border Integrated Quality Assurance — Grenzüberschreitende Integrierte Qualitätssicherung e.V. (GIQS) in Bonn, Germany.

1 'Quality and risk management in meat chains.'

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
[http://cordis.europa.eu/marketplace > search > offers > 8858](http://cordis.europa.eu/marketplace>search>offers>8858)

BIOLOGY AND MEDICINE

Improved gel matrices for tissue regeneration

European scientists are working on improved peptide-based hydrogels with antibacterial properties that could also support the growth of mammalian cells.



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Hydrogels constitute a novel way of autologous tissue engineering, as they provide the matrix for infused cells to grow and repair damaged tissue. However, application efforts have been compromised by bacterial infections that arise in the implants.

To overcome such challenges, the EU-funded Peptidebasedhydrogel¹ project aims to develop self-assembly peptide-based hydrogels that will allow the efficient culturing of cells while minimising the potential of bacterial growth.

Through modulation of peptide sequences, scientists designed a family of 10 novel peptides that could assemble into a fibrillar network. The surface chemistry of the fibrils could be controlled by simply modifying the amino acid composition of the peptide monomer used for self-assembly.

By analysing the peptide secondary structure, as well as the kinetics of peptide folding and self-assembly, it was seen that the generated peptides contained

distinct hydrophobic and cationic faces. The cationic face of each folded peptide remained exposed to the solvent and served as a potential warhead for bacterial engagement. The most effective antibacterial hydrogels proved to be those consisting of arginine-containing peptides.

After examination of the mechanical properties of hydrogels, the project has developed an optimised gel, composed of a peptide containing six arginine residues (PEP6R). PEP6R gels demonstrate high potency against bacteria, without the need for the addition of antibacterial agents. At the same time, they are compatible with the culture and growth of human erythrocytes and mammalian mesenchymal stem cells.

Hydrogel materials developed during the Peptidebasedhydrogel project can be used to coat implant surfaces or directly treat wounds in order to prevent or kill existing infections. Apart from its commercial utility, the project's technology provides useful insights into how composition influences peptide self-assembly and antibacterial properties.

The project is coordinated by the Instituto de Medicina Molecular (IMM) at the Faculty of Medicine of the University of Lisbon, Portugal.

1 'Toward the development of peptide-based hydrogels for tissue regeneration applications with inherent antibacterial activity'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8815

Harnessing fungal-plant relationships for greener cultivation

Symbiotic relationships between fungi and plants in the rhizosphere result in the production of plant-signalling chemicals. Modulation of these molecules could be a potent means for chemical control of parasites and nutrition.



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Beneficial associations between soil micro-organisms and plants are a prime example of how plants have evolved to overcome unfavourable environmental conditions. *Arbuscular mycorrhizal* (AM) symbiosis means that the plant gains nutrients, particularly phosphate. One advantageous spin-off for the AM fungus is a supply of carbon, enabling completion of its developmental cycle.

The molecular dialogue between symbiotic partners, it seems, is not private but is open to access by other organisms resulting in other relationships that may be beneficial or detrimental. The EU-funded Apomyc¹ project focused on the importance of the apocarotenoid group of molecules. Included in this group, which occurs widely in living organisms, are the 'Phytohormones strigolactones' (SLs) and 'Abscisic acid' (ABA).

Previous research by a member of the Apomyc team has shown that ABA is a regulator of SL production. By generating transgenic tomato plants, Apomyc scientists confirmed and characterised the key role of ABA in SL production and regulation of plant architecture.

Root parasitic plants, the *Orobanchaceae*, were shown to use SLs as potential host cues. This family of parasites carries huge economic importance due to crop damage, so this opens up the possibility of using SLs as a source of biological control. Moreover, Apomyc researchers demonstrated that AM symbiosis reduced germination of branch broomrape, which also parasitises tomato plants. Genetic manipulation of SL synthesis was shown to reduce root parasitism by branch broomrape without compromising AM symbiosis.

Apomyc detected divergent responses by the tomato to a variety of AM fungi. Overall, project results suggested that the specific responses caused differential impact on plant physiology

and the ability of plants to deal with biotic stress.

Work by Apomyc shows great potential for manipulating the signalling mechanisms in AM symbiosis for biological weed control. A reduction in agrochemical input on crops would be advantageous from both an environmental and economic perspective.

The project was coordinated by the Spanish National Research Council — Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC).

1 'Apocarotenoids as signaling molecules in the arbuscular mycorrhizal symbiosis'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8807



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Sounding out bubbles in pipes

An international team led by European researchers has come up with a new method of measuring gas bubbles in pipelines, enabling workers to avoid bubble 'blow-outs' like the one that took place in the Gulf of Mexico in 2010.

Pipes and pipelines have become the 'veins' of modern society. They transport precious fuels like oil and gas from the ocean floor depths, across country borders, through cities and into our homes. But that first step, to bring oil and gas through pipes from the seabed, is a complex procedure fraught with dangers due to the changing pressures involved.

In April 2010, the world was shocked by the environmental damage caused by a methane gas bubble which triggered an oil-rig blast, killing 11 people in the Gulf of Mexico. A small methane bubble expanded to such a large size that it shot oil 240 feet (73 metres) into the air. To avoid accidents like this, the ability to measure gas bubbles in pipelines is vital to the manufacturing, power and petrochemical industries.

New research from the University of Southampton in the United Kingdom, however, presented in the Royal Society journal *Proceedings of the Royal Society A*, has devised a new method to more accurately measure gas bubbles in pipelines.

From the bottom of the seabed to the water's surface, there is a difference in pressure. Any bubbles present in the oil or gas being brought up through the pipe will naturally expand as the pressure reduces the closer to the surface it gets. These expanding bubbles can cause a blow-out, which is the sudden release of oil and/or gas from a well.

At the moment, gas 'bubble-size distribution' (BSD) is estimated by sending sound waves through the bubble liquid and comparing the measured attenuation of the sound wave (loss in amplitude as it propagates) with that predicted by theory.

Problems surface when transferring theory into practice. According to theory, the assumption is made that bubbles exist in an infinite body of liquid. This could lead to errors in the estimation of the bubble population.

The European-led research team, headed by Professor Tim Leighton from the Institute of Sound and Vibration Research at the University of Southampton, has devised

a new method, which takes into account the fact that bubbles exist in any pipe.

They measured how phase speeds and attenuations in bubbly liquid in a pipe might be inverted to estimate the BSD (which was independently measured using an optical technique). This new technique, appropriate for pipelines such as the target test facility (TTF) of the USD 1.4 billion Spallation Source (SNS) at Oak Ridge National Laboratory (ORNL), Tennessee, United States, gives good BSD estimations if the frequency range is sufficiently broad.

According to Professor Leighton, 'This paper reports on the method we devised halfway through the research contract. It works, but just after we designed it the 2008 global financial crash occurred, and funds were no longer available to build the device into the mercury pipelines of ORNL. A more affordable solution had to be found, which is what we are now working on. The original design has been put on hold for when the world is in a healthier financial state. This has been >

ENERGY AND TRANSPORT

a fantastic opportunity to work with nuclear scientists and engineers from ORNL and [the Rutherford Appleton Laboratory] (RAL).'

Professor Leighton and his team were commissioned to undertake the work as part of an ongoing programme to devise ways of more accurately estimating the BSD for the mercury-filled steel pipelines of the TTF — one of the most powerful pulsed-neutron sources in the world.

This facility is capable of firing a beam of protons using a linear accelerator hundreds of metres long, into 20 tonnes of

pumped liquid mercury. Specialised neutron instruments are built in a circle around the source to catch the beams of neutrons and use them to probe the internal structures of materials, to test aircraft wings, forensic samples and biomedical products.

'The SNS facility was built with the expectation that every so often it would need to be shut down and the now highly radioactive container of the mercury replaced by a new one, because its steel embrittles from radiation damage,' said Professor Leighton. 'However, because the proton beam impacts the mercury and generates shock waves,

which cause cavitation bubbles to collapse in the mercury and erode the steel, the replacement[s] may need to be [made] more often than originally planned at full operating power. Indeed, achieving full design power is in jeopardy.'

This study was led by scientists at the Institute of Sound and Vibration Research at the University of Southampton, United Kingdom.

Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 25733

Smart ICT for energy efficiency

Amid rising energy demand around the world, securing resources and increasing environmental awareness, saving energy, improving transmission and distribution, and generating power from renewable sources have become priorities for Europe.

Energy efficiency is the catchphrase of the early 21st century. Changing the way we generate, transmit, distribute and use energy will have a major impact on every segment of European society, from big industry to household consumers. Improving energy efficiency will save money, help protect the environment, create new jobs, spur economic growth and improve security of supply by reducing Europe's dependency on imported fossil fuels.

With those goals in mind, and aiming at reducing energy consumption across the EU-27 by 20% by 2020, the European Commission's Communication 'Energy 2020 — A strategy for competitive, sustainable and secure energy', adopted in 2010, called for action in energy efficiency, infrastructure and technology, as well as choice and security for consumers.

In the envisioned energy-efficient Europe of the future, new technologies will have a big role to play. 'Dumb energy', squandered carelessly at the flick of a light switch or the rev of a car engine, will be replaced by 'smart energy', enabled by 'information and communication technologies' (ICTs) that allow consumers to

closely monitor their consumption and energy suppliers to more efficiently meet demand. In a nutshell: less waste, more gain.

'ICT can also give us a smarter two-directional power grid,' Neelie Kroes, Vice-President of the European Commission responsible for the Digital Agenda, has said 'especially at the retail level: getting real-time information on time and quantity of energy consumption, and allowing households to become energy suppliers to the grid.'

Already being rolled out in many countries, smart metering systems for electricity are a big step in that direction and have been shown to cut annual household energy consumption by up to 10%. Estimates also suggest that smart electricity grids, currently at the pilot project stage, could reduce CO₂ emissions in the EU by between 9 and 15% and reduce primary consumption by the EU energy sector by almost 9% by 2020.

By giving consumers the ability to monitor their electricity consumption in real time, they offer a big incentive to save energy. Combined with ambient intelligence technologies,



smart metering will enable smart homes to adjust energy use dynamically, for example turning down the heating when no one is in or automatically adjusting the lighting depending on the activities taking place in a room.

For electricity suppliers, smart grids ensure energy gets where it is needed when it is needed by accurately matching supply with demand, thereby reducing the need for wasteful excess capacity, while enhancing the integration of renewable energy sources such as wind and solar that are prone to erratic spikes and dips in generation.

'We will have to address the issues that stand in the way of full implementation of smart grids right now. We cannot afford to miss out on the opportunities an upgraded electricity system would offer in terms of decarbonising our economy and providing real added value for consumers,' noted Günther Oettinger, European Commissioner responsible for Energy.

Upgrading the grids: challenges ahead

However, there are several challenges to upgrading Europe's electricity grids, which were considered state of the art when they were deployed in the middle of the last century but will be obsolete in the smart energy world of the future.

The 'SmartGrids ERA-Net' project is addressing those challenges, developing transnational research activities to speed up the development of a 'Smart European Electrical Infrastructure' with the support of a wide spectrum of stakeholders, including energy suppliers, technology companies, regulators and end-users.

They are studying the many issues facing the roll-out of smart grid infrastructure, from methods to improve electrical transport and distribution systems in order to facilitate the integration of renewable energy sources and improve the sustainability of supply to addressing regulatory issues and the development of effective energy

markets. The project's goal is to lay the groundwork for the development of a smart, robust and effective pan-European grid that is capable of meeting future demands.

Information and energy: a smart marriage

In meeting that goal, the Internet will have a crucial role to play, given that in the smart grids of the future information will need to be distributed alongside energy.

The Finseny¹ project is specifically tackling this energy-information integration, bringing together key actors from the energy and ICT sectors to identify the ICT requirements of smart energy systems. The researchers are planning a trial of how a future ICT-enabled smart grid might work.

'The Finseny consortium brings together the best expertise in the field of ICT, energy, research and the world of academia to create innovative solutions in the energy field in order to optimise the delivery of energy to homes, buildings, industries and cars. This approach will not only change the way we live, but will also offer new business opportunities and will allow new competitors to enter the energy market and, at the same time, reduce CO₂ emissions and improve the environment in which we live,' explains Werner Mohr, the Finseny project coordinator at Nokia Siemens Networks in Germany.

In a similar vein, the IoE² project is developing hardware, software and middleware for seamless, secure connectivity and interoperability by connecting the Internet with energy grids, primarily with the aim of enabling the widespread use of electric vehicles.

The benefits of this approach are two-fold. On the one hand, IoE is supporting the development of the future electric grid by using data communication to move electricity more efficiently, reliably and affordably and, on the other, the project is contributing to the development of the future Internet by using

the electric grid to facilitate and speed up the communication among the various energy nodes and domains.

Using power lines to transmit data as well as electricity for smart grid applications is also the focus of the Integris³ project. The pan-European consortium is developing a novel and flexible ICT infrastructure based on a hybrid of 'Power-line communications' and wireless technologies to efficiently fulfil the communications requirements of future smart grids. The team's approach, which will be tested in a series of field trials, covers applications such as monitoring, customer integration, demand-side management, voltage control, quality of service control, control of distributed energy resources and asset management for power suppliers.

Thinking locally, saving globally

At a more local level, the IREEN⁴ project is investigating strategies to create energy-efficient neighbourhoods and communities. Working with a wide range of stakeholders, including technology, energy and construction companies, local authorities, building managers and owners, the IREEN team hopes to extend the concept of energy-positive homes (i.e. homes that generate more energy than they consume) to larger areas, laying the foundations for highly-energy-efficient smart cities.

Other projects are working even further down the energy chain on ways to save energy within individual homes and buildings.

The researchers behind the SEEDS⁵ initiative, for example, are using advances in self-learning methods, wireless-sensor technology and building technology to develop a novel energy-management system that will allow buildings to continuously learn to maintain user comfort while minimising energy consumption and CO₂ emissions. The technology is to be tested at offices and car parks in Spain and on a university campus in Norway.

Meanwhile, in the S4EeB⁶ project, researchers are innovatively using sound sensors to determine occupancy in a building so that heating, air-conditioning, ventilation, lighting and other systems can be automatically adjusted.

Besides buildings, big gains in energy efficiency are also possible through the implementation of ICT solutions in many sectors from industry and commerce to transport. The E-SAVE⁷ project, for example, is contributing to the development of energy-efficient supply chains by providing tools to help companies monitor, manage and share energy use and carbon footprint data in order to support supply-chain-design decisions.

And in the automotive sector, the NoWaste⁸ project is developing an engine waste-heat recovery and reuse system that promises to improve energy use by as much as 15%.

Individually, these EU-funded initiatives and many like them promise to have a big impact on energy efficiency. Combined, these emerging technologies will help Europe reduce energy demand, integrate more renewable sources, lower costs for consumers, create new jobs and new markets, and improve the security and sustainability of energy supplies.

- 1 'Future Internet for Smart Energy'.
- 2 'Internet of Energy for Electric Mobility'.
- 3 'Intelligent Electrical Grid Sensor Communications'.
- 4 'ICT Roadmap for Energy Efficient Neighbourhoods'.
- 5 'Self-Learning Energy-Efficient Buildings and Open Spaces'.
- 6 'Sounds for Energy Efficient Buildings'.
- 7 'Energy Efficiency in the Supply Chain through Collaboration, Advanced Decision Support and Automatic Sensing'.
- 8 'Engine Waste Heat Recovery and Re-Use'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'.
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ENERGY AND TRANSPORT

Renewable energy in the form of oil from algae

World petrol/diesel consumption is creating supply disturbances as well as having detrimental effects on the environment. EU-funded researchers are investigating oil from algae as superior even to the conventional alternative of crop-based biomass.



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Among the many alternatives to fossil fuels that have been proposed is the use of renewable biomass. Crop-based terrestrial sources of biomass, such as oil of palm, face problems associated with finite area of land available for cultivation. Efficient algal oil production could solve this problem.

In addition, certain algal species produce more energy than their crop-based counterparts, produce more biomass per hectare of cultivation area, and have faster growth rates than biofuel crops.

In order to investigate in greater depth the feasibility of using algae as a feedstock for producing biofuels, European researchers initiated the Mabfuel¹ project.

Scientists focused on both native seaweed and cultured micro- and macro-algae in an effort to identify species and processes with the greatest potential for fuel production.

Sampling of 16 macro-algal species included pretreatment to enhance oil extraction followed by subsequent analysis of hydrogen and methane production. Scientists

then selected *Batella bifurcata* (*B. bifurcata*) for continued testing. Land-based tanks to culture *B. bifurcata* will be implemented to evaluate the feasibility of large-scale production.

Long lines of the macro-alga *Laminaria digitata* (*L. digitata*) have also been placed next to salmon cages with initial bioremediation and data collection under way.

Furthermore, four promising micro-algal species have been grown successfully indoors in transparent plastic culture bags and outdoors

in shallow ponds. Scientists identified *Phaeodactylum tricornutum* (*P. tricornutum*) as having the highest growth rate. In addition, scientists developed ways to reduce the large energy requirement associated with harvesting and centrifugation to separate the algae cells from water.

To determine the harvest time associated with the maximum extraction of biofuel derivatives, the scientists are developing a rapid screening method.

Continuation of the Mabfuel project should provide appropriate algae-based biomass feedstocks and the technologies to produce and extract oil such that biofuel can become a profitable and attractive business sector. Commercial exploitation has the potential to significantly reduce dependence on fossil fuels, reduce greenhouse gas (GHG) emissions and boost local economies.

The Mabfuel project is coordinated by researchers at the Daithi O'Murchu Marine Research Station, Ireland.

1 'Marine algae as biomass for biofuels'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace>search>offers>8708>

Automatic temperature regulation without energy input

EU-funded researchers worked to develop processes for maintaining a constant temperature in everything from buildings and freezer trucks to swimming pools without the need for energy input.

Heating and cooling homes and businesses typically requires electricity, in most cases provided by the burning of fossil fuels. The same is true for the refrigeration and cold storage of foods.

A class of materials able to absorb heat when temperature rises and release it when temperature falls (so-called

phase-change materials, PCMs) may be the perfect way to maintain a constant desired temperature based simply on the heat absorption properties of the materials chosen, with no external inputs or controls.

Although applications are virtually limitless, commercial exploitation has been minimal

due to high production and encapsulation costs. In addition, mechanical strength testing of commercial microencapsulated PCM products has been lacking.

To address these issues, European researchers initiated the Effbuildings¹ project with the goal of developing new production technology based on the use of

waste products, innovative encapsulation methods and new testing techniques.

Effbuildings has initiated research regarding PCM use in cold stores and industrial freezers as well as vacuum impregnation of PCM in porous natural products for use in building materials such as concrete and wood.

In addition, computer modelling work was initiated to evaluate the use of PCM in regulating water temperature in open-air

ENERGY AND TRANSPORT

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swimming pools. Two new testing systems were constructed to assess the thermal performance of the composite materials.

Continuing efforts in this field of enquiry should have an important impact on the commercialisation of PCM-based components for temperature regulation in a wide variety of applications.

The project was coordinated by the Universidad de Lleida in Spain.

- 1 'Thermal energy storage with phase change materials for energy efficiency of European building stock'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8749

Superconducting cables for electricity grids

Power grids around the world are reaching their limits at the same time that electricity demand is growing. EU-funded researchers developed and tested one of the first superconductor-based cables to address the issue.

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'High-temperature superconducting' (HTS) cables have attracted attention in the last couple years as a solution to the shortage of transmission capabilities. Superconductors are materials that lose their resistance to the flow of electrons when cooled to temperatures close to absolute zero — hence, they conduct electricity almost ideally.

In addition to their electrical capabilities, HTS cables are also particularly attractive for several other reasons. They are compact,

thus requiring less underground space where lots of piping and other structures already exist. They are also more environmentally friendly, conserving energy and resources and delivering power while generating no external magnetic fields.

Several prototypes have been produced worldwide based on multi-filamentary wires. However, the technology is expected to be replaced in the near future by more cost-effective HTS-coated conductor (CC) tapes.

European researchers initiated the Super3c¹ project to develop, manufacture and test a 30-metre prototype system expected to be the first in the world based on low-loss HTS cable technology using CC tapes.

Extensive modelling resulted in the design of HTS cable and terminations that were validated in prototype testing. Simultaneously, scientists developed an HTS copper hybrid CC tape manufactured using two well-established processes: 'Ion

beam-assisted deposition' (IBAD) and 'High-rate pulsed-laser deposition' (HR-PLD). In order to achieve superconductivity, a cryogenic envelope consisting of a liquid-nitrogen cooling system was incorporated.

The consortium delivered a 30-metre HTS power cable, one of the world's first, with terminations and a cooling system that was successfully tested and shown to meet power objectives.

Innovation enabled a careful evaluation of integration of such cables into existing power grids as well as economic comparison with other available technologies.

The Super3c project has positioned Europe as a world leader in superconducting CC technology. It promises to be the high-capacity environmentally friendly and economical solution to upgrading the world's electricity grid.

The project was coordinated by Nexans France, based in France.

- 1 'Super coated conductor cable'.

Funded under the FP6 programme 'Sustainable Development, Global Change and Ecosystems'.
<http://cordis.europa.eu/marketplace> > search > offers > 8951

ENERGY AND TRANSPORT

Mimicking plants for clean, renewable energy

European research is on track to develop a catalyst that would do the work of the complex bio-machinery of the plant in photosynthesis. The result would be hydrogen and oxygen, and renewable and clean fuels.



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The first part of plant photosynthesis basically uses solar energy to split the water molecule by photo-oxidation and form intermediates molecular oxygen (O₂) and hydrogen ions. Combined with carbon dioxide (CO₂), the hydrogen ions form glucose through two complex cycles and the sun's energy is locked for further use by plants or herbivores.

Harnessing the light phase in artificial photosynthesis is therefore one of the most promising processes for the direct

conversion of sunlight energy into renewable chemical fuels, molecular hydrogen and oxygen. Much research is being ploughed into novel highly efficient catalysts that can facilitate water oxidation as well as identifying the fundamental reaction mechanisms behind their efficiency and function.

The H₂Osplit¹ project focused research efforts on inorganic ruthenium-containing polyoxometalate homogeneous catalysts, a recently synthesised group of molecules that have a

high level of reactivity and stability in solution.

Using first principles 'Density-functional theory' (DFT), the energetics as well as the structural and electronic properties of the intermediates in the oxidation of the four RuIV-H₂O units were studied. After characterisation of the reaction intermediates in the gas phase, the H₂Osplit team showed there was a solvent-induced structural distortion on the solvated tetraruthenate core. This prediction is in line with experimental X-ray diffraction data.

The calculated electronic properties of the catalyst are weakly dependent on the presence of the solvent. The initial states and those involved in the electronic states of the electron transfer for the oxidation of the four catalyst-H₂O units are localised on the tetraruthenium-oxo core. However, the free energy difference between the initial and the activated state is significantly lower than the thermodynamic limit for water oxidation. H₂Osplit suggests that higher oxidation states are required.

The main results of the project so far have been published in the journal *Physical Chemistry Chemical Physics*. With the development of catalysts able to undergo the key steps of photosynthesis, water and sunlight could be the only feedstock needed for renewable energy production.

The project was coordinated by the Consiglio Nazionale delle Ricerche, Italy.

1 'Water splitting catalysts for artificial photosynthesis'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8732

Automated high-voltage transformer-monitoring system

EU-funded researchers have developed an automated system for monitoring insulation oil vital to extending the lifetime and reliability of Europe's power transformers.

High-voltage power transformers are devices used worldwide by the power industry to control and deliver electricity.

Most of the transformers in service in Europe today were installed nearly 50 years ago and are reaching the end of their functional lifetimes. Simultaneously, deregulation of the power industry

has led to increasing competition, favouring lower prices for consumers but resulting in less money available for capital investment and maintenance.

So-called blackouts are increasingly common and there is an urgent need to extend the life of existing transformers while improving their reliability.

Oil is often used to provide insulation among internal parts of the transformer as well as to cool it, and is arguably the most influential factor in extending the service life of transformers.

European researchers working on the Transman¹ project sought to produce an automated power transformer oil-insulation



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monitoring and treatment system. In particular, they set out to develop low-cost online

ENERGY AND TRANSPORT

dehydration and particle removal technologies for transformer oils.

To this end, investigators developed an online moisture-removal system from recyclable packing material as an alternative to conventional materials that must be disposed of as chemical waste.

Another development was a novel real-time optical particle sensor to illuminate the oil sample, minimising light scattering

and maximising contrast for enhanced detection. Rotation of porous membranes in the particle filtration unit caused turbulent flow of particles across the membrane surface, minimising particle deposition and pore blockage with respect to conventional cross-flow filtration units.

Researchers also developed intelligent transformer management software to enable online real-time data analysis.

Transman has delivered a cost-effective, compact prototype device for power transformer oil-insulation monitoring and treatment. Further research should facilitate full exploitation of the significant market potential, enhancing the competitive edge of small and medium-sized enterprises (SMEs) working in the power industry while ensuring reliable energy supply to consumers throughout Europe.

Lead contractor on the Transman project was Kelman Ltd. of Lisburn in Northern Ireland.

- 1 'A product to extend the life of energy transmission and distribution transformers by total management of insulation systems'.

Funded under the FP6 programme
'Horizontal research activities involving SMEs'.
<http://cordis.europa.eu/marketplace> >
search > offers > 8579

Exploiting the offshore sector

Deep-sea technology and harnessing sustainable energy from the sea could mean that Europe's offshore economy will boom for many years to come.



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The offshore economy, i.e. offshore engineering, floating structures, survey vessels, cable laying and sub-aquatic equipment, is considered the second most important economic sector in Europe.

The EU-funded Acmare (CA)¹ project articulated technologies and resources needed to progress in the sector, such as those related to producing hydrocarbons from the sea,

undersea drilling, pipeline installation, renewable technologies and carbon dioxide (CO₂) capture. The project also considered reduction of environmental impact on producing, transporting, delivering and exploiting energy, and involving an eventual shift from natural gas to hydrogen-based energy.

The challenges in the sector are many, such as the inability to transmit radio through water and

no global positioning system on the sea floor. This requires development of a whole new sub-decimeter geodesic system. Also important is the 'marinisation' of production process on floating structures, i.e. moving production and processes from sea level to sea floor and migrating to deeper waters.

Project recommendations have included horizontal cooperation between enterprises, formation

of multinational teams and trans-sectoral collaboration with other high-tech dependent industries such as aeronautics and information technology (IT). Acmare (CA) also called for political and financial support to yield a more competitive European industry, open new markets, develop innovative technologies and achieve substantial reduction of CO₂ emissions. It highlighted the two main priorities as being demonstration and deployment of technologies whose feasibility is already proven, as well as development of innovative high-technology solutions for the sector.

The most crucial new technologies to develop would include innovative deep-water production equipment, robotics, deep-sea service vessels and offshore renewable energy production, in addition to gas liquefaction and LNG vapourisation. With a detailed roadmap, these important areas are enough to keep the European offshore economy busy for decades.

The Acmare (CA) project was coordinated by the Community of European Shipyards Associations (CESA), Brussels, Belgium.

- 1 'Co-ordination Action to implement an Advisory Council for Maritime Transport Research in Europe'.

Funded under the FP6 programme
'Sustainable Development, Global Change and Ecosystems'.
<http://cordis.europa.eu/marketplace> >
search > offers > 8538

ENERGY AND TRANSPORT

Intelligent cargo for more efficient, greener logistics

EU-funded researchers have developed a proof-of-concept 'intelligent cargo' system that promises to revolutionise the freight industry, improving efficiency, saving suppliers and recipients time and money, and helping protect the environment.



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Millions of trucks, freight trains and cargo ships are on the move around the world each day. Combined, they account for more than 14% of global greenhouse gas emissions and consume around a third of total energy consumption. Wastefully, many of those vehicles are travelling empty.

Despite efforts to improve freight-transport efficiency, a cargo truck plying Europe's roads will currently still spend around half of its working life empty — returning from a delivery or travelling to pick up its next shipment. But what if cargo was made aware of its context and purpose? It could find space on a passing truck, let logistics operators know where it is and keep recipients informed of its estimated time of arrival. Perishable and hazardous goods could be closely monitored, transport routes dynamically changed to avoid congestion, and the entire

transport industry made dramatically more efficient.

'Put simply, intelligent cargo is about giving cargo the capacity to understand who I am, where I am, what my mission is and what I should do if something goes wrong,' says Margherita Forcolin at the IT services company Insiel in Italy. 'From an artificial intelligence point of view, it's a basic level of intelligence — it simply reacts to what's going on around it, but from a logistics viewpoint it's a huge step forward.'

Insiel coordinated a consortium of 22 companies, universities and research institutes in defining concepts and developing technology for an intelligent cargo system based on a combination of sensor networks, wireless communications and ambient and artificial intelligence. Supported by EUR 8.25 million in funding from the European Commission, the

team behind the Euridice¹ project implemented their system in eight different pilot studies involving transport and logistics operators across Europe.

Euridice aimed to use 'cooperative systems' — systems (or objects) that communicate with each other and their surroundings — to provide the right information in the right place at the right time at low cost, using modern communication networks.

Intelligent cargo

The Euridice definition of intelligent cargo is built on six key capabilities.

To begin with, the cargo needs to be able to identify itself so that an operator at a warehouse can ask a container, pallet or box for its unique ID and determine what is inside. The operator, in turn, should then be able to access information services

from the owner, haulier and customs authority to determine the nature, route and clearance status of the goods.

The cargo also needs to be aware of its context, enabling it to report, for example, that it is inside a truck on the road or waiting to be picked up in a storage depot. It should also monitor and report its status which, depending on the type of cargo, could mean checking its temperature, humidity, whether it is still sealed or has been hit or damaged in anyway.

This information, combined with artificial intelligence technology, enables the cargo to act independently and make autonomous decisions, for example, alerting logistics planners automatically if it deviates from the predefined route, if there is a delay.

'There are two parts to the system: the sensors, data storage, software and transmission components on the cargo and a connected fixed infrastructure that handles the overall management of the system,' explains Ms Forcolin, who coordinated the development and deployment of Euridice.

Precisely what components need to be used and how depends on the intended application. A shipping container, for example, could be fitted with a range of sensors to monitor all of its contents and its whereabouts, whereas a product package could be tagged with an RFID chip that simply tells logistics operators what it contains and where it is going.

The back-end infrastructure is similarly flexible. It could be installed by a logistics company to manage all of its operations or by a third-party service provider offering services to a cluster of transport firms, suppliers and product recipients.

'We have looked at many different business models. Ultimately, how a system like this is implemented and used will be determined by the end-users and the

ENERGY AND TRANSPORT

market,' Ms Forcolin notes. 'The overall concept is to have cargo that is able to communicate important information about itself to the infrastructure and from there to all the stakeholders in the transport chain. Although we talk about intelligent cargo, from a technical viewpoint it's really cargo intelligence — it's a distributed intelligence achieved through different means and processes.'

Solving real-world problems

The enormous potential of the approach was demonstrated by the Euridice team in eight pilot implementations that showed how intelligent cargo and cargo intelligence can solve a variety of real-world problems within different areas of the freight industry.

One pilot focused on using the system to interconnect transport and production processes. Working with Italian eye-wear manufacturer Safilo, a project

partner, technology was implemented to provide the company with automated real-time information about the whereabouts of eye-wear components, from before they leave the supplier's factory until they check in at the company's warehouse.

Equipped with the real-time information about all the parts — even from different suppliers — Safilo could better schedule assembly and manufacturing processes, avoiding delays, reducing costs and improving production efficiency.

With Fiorital, another pilot end-user, the logistics requirements were different. The company deals with the distribution of perishable consumer goods, such as fresh fish, and needs to closely monitor the status, storage conditions and transport history of its products. In the trial, the EURIDICE implementation enabled Fiorital to monitor in real-time the temperature and

conditions of the product during transport and receive automated alerts in the event of an incident.

And what happens after the goods have been safely delivered on time?

At Gebrüder Weiss, an Austrian logistics service provider, the Euridice system was implemented to optimise the return of empty pallets and boxes and ensure that trucks do not return empty. The trucks automatically advertise that they have space available and the boxes and pallets inform operators that they have been unloaded and are waiting to be returned.

'Individually, the pilots represented elements of a real-world supply chain. Together, they covered an almost complete supply-chain scenario,' Ms Forcolin says. 'There are so many possibilities for this type of intelligent system. Looking ahead, I can imagine having an intelligent system

on the cargo communicating with the vehicle which in turn communicates with the transport infrastructure, the roads, ports, etc. — it's the vision of the "Internet of Things".'

With several of the partners continuing to build on the work carried out in Euridice, that vision of a more intelligent, more efficient and more environmentally friendly transport sector could come about sooner rather than later.

The Euridice project is led by the Italian information technology company Insiel.

1 'European inter-disciplinary research on intelligent cargo for efficient, safe and environment-friendly logistics'.

Funded under the FP7 specific programme 'Cooperation' under the theme 'Information and Communication Technologies' (ICT).
<http://cordis.europa.eu/marketplace> > search > offers > 8697

The road to heavy-duty fuel cells

Fuel cells have already powered small road vehicles all over the world, but the challenge is on to perfect the technology for rail, trucks and even yachts. A new European initiative brings us closer to this objective.



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Visionaries have dreamed of making heavy-duty vehicles operate on super fuel cells (FCs), from large cars and trucks to trains and boats. Such a vision has come within the grasp of

science, thanks to the efforts of the EU-funded Felicitas¹ project.

The project worked on developing FC technologies for heavy-duty road, rail and marine transport using 'Polymer-electrolyte fuel cells' (PEFCs) and 'Solid-oxide fuel cells' (SOFCs). It aimed for cells that provided over 200 kW electrical output and over 10 000 hours operation time, as well as a system efficiency of over 60%. This involved exploitation of 'Proton-exchange membrane' (PEM) technology that could eventually even power heavy-duty vehicles such as inner-city buses.

After intense research, design and testing, the project made remarkable progress in furthering its objectives. In addition to considering pure hydrogen, it

investigated the use of different hydrocarbon-based fuels as a precondition for most heavy-duty applications. Felicitas also made headway in using gas turbines to increase electrical efficiency and promote intelligent reuse of thermal energy in SOFC.

The project successfully designed hybrid PEFC clusters that were ideal for public-transport applications such as city buses, light rail or trams in urban areas, but not for heavy rail, tram or truck applications. On the other hand, although the project made significant headway in developing Rolls-Royce hybrid SOFCs, the technology still needed modifications before being successfully used in marine applications.

Other key achievements of the project included doubling the

lifetime for single PEFC systems in hybrid configurations, as well as over 60% efficiency for hybrid SOFC and PEFC systems. While more work is needed to achieve the heavy-duty applications envisioned, the overall progress has helped advance FC technology in numerous ways, bringing much optimism to the future of cleaner transport.

The Felicitas project is coordinated by the Fraunhofer Institute for Transportation and Infrastructure Systems (IVI) in Dresden, Germany.

1 'Fuel cell power trains and clustering in heavy-duty transports'.

Funded under the FP6 programme 'Sustainable Development, Global Change and Ecosystems'.
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ENVIRONMENT AND SOCIETY



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How trees can help poor farmers

Meeting the challenges of a changing climate and degraded natural resources requires a new and innovative approach to sustainable agriculture. The Funtree¹ project is studying 'agro-forestry systems' (AFSs) and the factors affecting or preventing their adoption in two sub-Saharan sites, in Mali and Senegal.

The project set out to develop regionally specific, trait-based and field-tested AFSs ready to be implemented in semi-arid Africa and Central America. The main aim is to provide farmers with a portfolio of regionally suitable tree and shrub species, organised by their traits or attributes, which can provide a range of agricultural products and ecological functions, as defined by the farmers themselves. Comparing research results from Africa with a third field site based in Central America has also enabled the researchers to test the generality of the findings in seasonally dry environments.

*Research*eu results magazine* asked the project's coordinator Graciela M. Rusch — Senior Research Scientist at the Norwegian Institute for Nature Research (NINA) — to explain in a little more detail what the project is working on.

What is the Funtree project setting out to achieve?

The main theme of Funtree is about the attributes of trees and how they determine the ecological and productive functions they perform in agro-forestry systems, especially in seasonally dry tropical regions. Funtree focuses on the diversity of these attributes and how this diversity underpins the provision of multiple benefits to farmers and to the various users in rural communities in Central America and West Africa.

The main objective is to understand better how the attributes of trees correspond to functions that are important in the farm, both from a production and an ecological perspective. Also, to investigate which functions trade-off against each other, which leads to the question: if one chooses tree species with

certain characteristics, what benefits will be gained, and which ones are incompatible with them?

Another objective is to make those who receive benefits from AFSs aware of the variety of benefits that derive from such functionally diverse systems, and to draw the attention towards trees that are seldom part of conventional agro-forestry recommendations, which often concentrate on just a few varieties.

Funtree then aims to communicate these findings to the farmers in an inclusive and participatory way, with the purpose of raising awareness about the implications of the choices they make in terms of production and of the ecological properties of the agro-forestry systems they manage.



© Graciela M. Rusch

Graciela M. Rusch

What is new about Funtitree and the way it is addressing these issues?

From the theoretical point of view, the most innovative aspect is that Funtitree brings in functional ecology theory to agro-pastoral forestry systems and the concept of functional diversity to assess impacts of production activities, as well as for the planning of more diverse agro-forestry systems. In more practical terms, we also had a challenge in setting up demonstration activities.

Demonstration parcels are difficult to set up within the course of a four-year project, particularly if we intend to disseminate findings produced by the project. Each site has identified a package of demonstration activities, with different methodologies, designed by the local research partners, which all aim to demonstrate the multi-functionality of agro-forestry systems and the diversity of functions provided by the local tree resources.

What first drew you to this area of research?

I am very interested in the field of the ecology of man-shaped ecosystems. In order to manage and use natural resources, we need to understand the fundamental biological and ecological processes that govern these systems. Through studying nature we can understand the processes by which life systems respond to and modify the environment.

Investigating anthropogenic systems — with similar approaches and theories to those that emerge from the study of natural systems — helps us to understand the consequences of anthropogenic impacts on life systems and provides the basis for planning a more sustainable use of biological resources.

What are some of the difficulties you have encountered in the Funtitree project?

Regarding the management and organisation of the project, it is always a challenge for a team to have partners geographically dispersed (in our case in Europe, West Africa and Central America). Also, many of us had never worked together before, and not all of us had work experience from both Africa and Central

America. Related to this was the problem of finding a common working language.

From the research point of view, the team is largely multi-disciplinary, with participants with different research backgrounds. We are foresters, agronomists, ecologists, soil scientists, eco-physiologists, economists, sociologists, etc. It was a challenge to communicate the principles of functional ecology and to translate them into the language and concepts of the different disciplines.

So, the language problem goes beyond communicating in French, Spanish, English, Norwegian or Dutch. It also arises from communication across cultures and scientific disciplines.

How do you go about solving such problems?

We solved the question of being geographically dispersed and the partners not knowing each other well by spending considerable effort in the first one-and-a-half years of the project in organising meetings at the three case study sites. We also organised workshops where field protocols and methods were discussed, developed and tried. Some of these were aimed specifically at training, because an additional challenge was that not all teams had sufficient methodological skills in all the areas of research. We also conducted joint fieldwork campaigns, which helped us to get to know each other and provided opportunities for discussion, fine-tuning the sampling protocols, and learning by doing.

Regarding the language problems, we have been lucky in having a diverse team with considerable international experience where almost everyone had command of two to three common languages and who have been willing to assist colleagues with more limited language skills. We also put effort into translating field protocols, presentations and other material.

Regarding the scientific language and the ecological concepts in the project, we have achieved progress in communication through exchange, talking at meetings and workshops, communicating by e-mail and other means. We have also been very fortunate to have a team with members who have been exposed to this kind of multi-disciplinary work before, and who are respectful of others' work.

What are the concrete results from the research so far — and how will they contribute to sustainable development?

We have learned much about the properties of the tree species that are common in the agro-pastoral landscape of the study sites, especially where knowledge of their ecological attributes — such as their different strategies of water economy, their forage

potential, how they affect the vegetation growing beneath them and the surrounding soil — had previously been limited.

In addition, we have a better understanding of how the farmers and other local users value the trees and their products, as well as the functions they play in the production systems. More functionally diverse and biologically more complex production systems are more versatile and better equipped to face significant changes, such as those expected to occur as a consequence of global warming.

What are the advantages of participating in an EU project?

I would say that, by far, it is the opportunity to participate in diverse research teams, not only scientifically but also culturally diverse. This enables us to look at research questions from a wider range of perspectives than would be the case with geographically, culturally and scientifically homogeneous research teams.

EU projects have the potential to facilitate a very productive exchange of ideas and experiences. Many different insights are brought to the projects and there is a potential for a rich exchange of viewpoints, ideas and methodologies. The experiences with Funtitree and the other EU projects I have participated in have been of great value. We are fortunate as scientists to have access to this amazing resource in Europe.

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

I am interested in understanding in greater depth the dynamics of these systems, such as how their attributes are linked to responses to environmental fluctuations. There are also many challenges about how to restore systems whose functional diversity has been degraded by overuse and/or bad practices. How to best promote restoration of the productive capacity without relying exclusively on introduced, cultivated species is a big challenge for many anthropogenic systems in the Tropics.

The Funtitree project is coordinated by the Norwegian Institute for Nature Research (NINA) in Norway.

1 'Functional diversity: an ecological framework for sustainable and adaptable agro-forestry systems in landscapes of semi-arid and arid eco-regions'.

Funded under the FP7 specific programme Cooperation under the theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).
For further information see the project website: <http://funtitree.nina.no>

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ENVIRONMENT AND SOCIETY



Europe, South Africa look to water conservation

The world's growing population and increasingly unpredictable climate is putting ever more pressure on water resources. Improving water-resource management is therefore of paramount importance in places like Africa.



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The people of the African continent have often felt, and continue to feel, the effects of a lack of safe drinking water. Avoiding human suffering on such a scale in the future will require more rational use of this limited natural resource.

In recent years, considerable progress has been made in 'Integrated water resources management' (IWRM). With the aid of EU funding, IWRM experts from the EU have combined forces with their counterparts in South Africa to improve the outlook for both water resources and their users in the region.

The LOGO WATER¹ project sought to educate and empower local government in the SADC. The first step involved collecting and disseminating information about best IWRM practices to government representatives.

By meeting and speaking directly with people from local agencies, the LOGO WATER team obtained a better understanding of the obstacles to proper water-resource management. For example, the regulatory framework is not ideal. It is also necessary to decide whether management will be implemented by region or by river basins, which often span several regions. Financial aspects must also be taken into account when responsibilities

are transferred from the state to regional authorities.

Based on the findings, the LOGO WATER team developed IWRM strategies targeted to the SADC. The hope is that the local governments will be able to transform these strategies into concrete action plans in the near future. The strategies and other reports can be found on the project website.

Finally, collaborations such as LOGO WATER are also contributing toward achieving the Millennium Development Goals related to water.

The LOGO WATER project was coordinated by ICLEI — Local Governments for Sustainability, European Secretariat, in Freiburg, Germany.

1 'Towards effective involvement of local government in IWRM in river basins of the Southern African Development Community (SADC) region'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
<http://cordis.europa.eu/marketplace>
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Advancing Africa's right to clean water

Many people in Sub-Saharan Africa suffer from the effects of poor sanitation. An EU-funded project set out to identify and implement sustainable, low-cost sanitation approaches in the region.

Nearly two-thirds of the population of Sub-Saharan Africa does not have access to sanitation facilities that ensure a clean and safe water supply, and which protects against the spread of disease associated with the bacteria in waste. Thus, the Millennium Development Goals (MDGs) for

sanitation cannot be met by 2015 as planned without significant improvements to the provision of sanitation services to Sub-Saharan Africa.

The Netssaf¹ project was initiated to develop collaboration among stakeholders to identify and

implement sustainable sanitation approaches integrating low-cost technologies with community-based management.

The investigators focused on West African countries and first identified settlements with no sanitation access. They then selected several case study sites based on a variety of factors, and assessed seven sanitation systems along with sustainable alternatives. The researchers identified potential sanitation providers by region,

creating a database of small and medium-sized enterprises (SMEs) operating in West Africa.

The final project outcome was development of a sanitation decision-support or management tool (Sanitation Management Support Tool) and a guide for its use to help stakeholders apply large-scale sustainable sanitation concepts to the varying conditions in West Africa. Implementation of the Netssaf project outcomes should help Europe and Africa to

ENVIRONMENT AND SOCIETY



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meet the MDGs for global sanitation access and thus enhance the lives of the millions of people in West Africa currently living without access to clean water.

The Netssaf project was coordinated by the Bremerhaven Technology Transfer Centre (TTZ), in Bremerhaven, Germany.

1 'Network for the development of sustainable approaches for large scale implementation of sanitation in Africa'.

Funded under the FP6 specific programme 'Sustainable development, global change and ecosystems'.
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Enhancing African smallholder farming productivity

It is generally accepted that Africa needs to increase agricultural productivity in order to meet the needs of a rapidly growing and urbanised population. However, finding broad agricultural solutions is particularly difficult given the diversity of types of farm.

The AfricaNUANCES¹ project was designed to address this issue by incorporating the variances to determine best

practices for achieving food security, sustainability and resilience of natural resources in Sub-Saharan Africa.

The project targeted humid and semi-humid ecosystems and developed an analytical model combining spatial and temporal characteristics of smallholder farming.

Specifically, the model considered crop production in relation to soil fertility as well as livestock production for various livestock systems and manure handling. Particular emphasis was given to efficient use of nutrients and to improving soil quality. In addition, the temporal characteristics were considered by including balances in feed, organic material and labour over time.

Researchers evaluated the model in terms of costs and benefits, in particular as related to productivity, economics and environmental services. As such, the project represents the first instance of simulation models incorporating agro-ecological and socio-economic parameters. In addition, the temporal characteristics of the model enabled careful analysis of the dynamic interactions between production,

consumption and resource management. Although the project focused on issues of soil fertility, the results are broadly applicable to the evaluation of agricultural processes.

Thus, the AfricaNUANCES project contributed a modelling tool of particular importance to Sub-Saharan Africa and its critical need to increase agricultural productivity amid the inherent complexities of its smallholder farms. The information was shared with local farmers and extension workers in addition to its free availability on the website, and should yield fruitful — or should that be 'legume-full' — results.

The project was coordinated by the Plant Production Systems Group at the Wageningen University, in Wageningen, The Netherlands.

1 'Exploring trade-offs around farming livelihoods and the environment: the AfricaNUANCES framework'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
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ENVIRONMENT AND SOCIETY



Restoring woodlands in Tanzania

The EU has taken an interest in preserving biodiversity in Africa, including rare woodlands in Tanzania. New methods and recommendations to enhance sustainability have borne fruit in helping Tanzania preserve its woodlands.



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The biodiversity of Africa is stunning, yet often comes under pressure from natural and man-made threats. The EU has backed numerous projects to address these threats, which have put Tanzanian woodlands in danger. The EU-funded Mitmiombo¹ project was one such project, which supported Tanzanian researchers to restore ecosystems and manage sustainable production.

It transferred cutting-edge methods to achieve project objectives

and establish research plots in the country to promote natural regeneration, as well as to study growth, variations, pest problems and tree diseases. In addition, the team members encouraged technology transfer, workshops and exchange visits among researchers, aiming to involve local communities, farmers and tree growers as well. Exchanges with researchers beyond Tanzania, with focus on other African countries and Europe, were also encouraged.

The project drew many valuable results from the test plots. It found that trees which make excellent timber constituted 55% of the overall mix, although those in certain areas do not grow continuously. It also concluded that using the Miombo woodlands for timber is unsustainable and that deforestation was occurring at an alarming rate, mainly due to turning it into charcoal.

Mitmiombo recommended instead the development of

second-generation biofuels that do not threaten the security of food and land, considering as well biodiversity in developing a bio-energy policy in forests. It advocated continued involvement of local communities and stakeholders in managing and regenerating the Miombo woodlands.

The project results were disseminated to interested researchers and have helped to secure funding for future projects to preserve Tanzanian woodlands. In the meantime, conservation methods developed during the project were well received and have proven successful with people on the ground. This bodes well for improving sustainability in Tanzania, positioning the EU as an important player in the region, too.

The Mitmiombo project was coordinated by The Finnish Forest Research Institute (Metla) in Vantaa, Finland.

- 1 'Management of indigenous tree species for ecosystem restoration and wood production in semi-arid Miombo woodlands in Eastern Africa'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
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New farms for new fish

An EU-funded project endeavoured to bring effective and profitable fishery establishments to Eastern Africa with the aim of alleviating these economically depressed regions.

The broad geographical area covering Ethiopia, Kenya and Uganda calls for the establishment of suitable sites for fisheries. To discover the most appropriate sites, the BOMOSA¹ project used feeder technology and fingerling transport protocols as criteria. Project partners pioneered a hub and plot system to integrate agriculture with aquaculture in an effort to

alleviate these poverty-stricken regions.

The evaluation plots were established in these three regions, covering four climatic zones: humid areas, river/lake floodplains, highlands and semi-arid regions. While remote sensing was used to evaluate potential areas for the new sites, each

was evaluated to meet the criteria of low cost, reliability, high accuracy, simplicity and universality.

In addition, veterinary and public health issues were addressed to ensure absolute food safety. This included evaluating water quality as a critical factor to ensure animal health. The

project determined that cooking the fish produced would be a sufficient precaution to ensure that no parasitic organisms entered the human food cycle.

BOMOSA also evaluated various feeding methods, developing feed packages and storage options. Agricultural by-products were examined for their nutrient values and criteria were established for potential dietary ingredients based on local availability and abundance.

ENVIRONMENT AND SOCIETY

The economic performance of these plots, as applicable to the individual farmer, was critical. Therefore, different strategies were developed to reduce fish

mortality during transport and to increase overall productivity, as well as smoking techniques to preserve of stock left over from over-production.

BOMOSA also looked into the factors of social acceptance, which included ethical and perceived benefits, management and environmental issues.

Addressing these enabled the development of a successful strategy, maximising sustainable production and continuation of a successful Technology Information Plan even after the completion of the project.

The BOMOSA project was coordinated by the University of Natural Resources and Life Sciences in Vienna, Austria.



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- 1 'Integrating BOMOSA cage fish farming systems in reservoirs, ponds and temporary water bodies in Eastern Africa.'

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
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Managing vegetation from space

Europe possesses the technology to monitor and manage its ecosystems from space. It has now turned to assisting African nations in exploiting this technology to help support agriculture and the environment.



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VGT generally refers to vegetation studied from space, as reflected in the EU-funded

VGT@WORK¹ project. The project worked on training for exploiting research related to monitoring

and managing terrestrial ecosystems.

VGT@WORK reinforced the capabilities of African project partners to monitor their vegetation from space by creating tools to manage agriculture, land use and rangelands. It built on past initiatives related to the 'Global monitoring for environment and security' (GMES) European programme, educating experts in target countries on transmitting new data to policy-makers and stakeholders.

The project achieved its aims by identifying target audiences and information needs. It then trained involved African scientists to use specific VGT software and arranged for many scientists to train both in Europe and in participating African organisations. This enabled the scientists to gather information on vegetation in their countries through the eyes of satellites on a continuous basis and feed this information to key stakeholders.

Apart from scientists, the project trained other end-users and developed the necessary documentation and software to assist all stakeholders. It ensured that these efforts continue after the project's end, encouraging the exploitation of data for many years to come. The results of VGT@WORK continue to foster the expert use of remote-sensing data to monitor and manage vegetation.

The VGT@WORK project is coordinated by the Teledetection and Earth Observation (TAP) division of the Flemish Institute for Technological Research in Mol, Belgium.

- 1 'How space helps to manage ecosystems'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
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ENVIRONMENT AND SOCIETY



Sharing water fairly for mutual benefit

Water is a critical natural resource whose scarcity, either due to natural environment effects or poor management, takes a great toll on biodiversity, economic development and human survival. EU-funded researchers investigated the overlapping and often conflicting goals of water-resource management, biodiversity conservation and livelihood sustainability in semi-arid regions of Africa, with important implications for policy development.



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Limited access to water in semi-arid developing regions has led to pressure to use the water for 'higher economic value' activities rather than fostering ecosystem preservation and protection of the livelihoods of inhabitants.

In semi-arid regions of Africa, programmes for 'Integrated water resource management' (IWRM), 'Sustainable livelihoods' (SL) and 'Biodiversity conservation' (BC) have evolved

independently, leading to increased poverty and decreasing biodiversity.

The Intrepid¹ project was undertaken to highlight the necessity of integrating BC to increase environmental security, participatory democracy to enhance social security, and higher income per capita to fuel economic growth. The project built on the European Water Framework Directive (WFD) and used the Mara river basin system in Kenya

and Tanzania as a case study to develop a conceptual framework to focus research efforts and policy initiatives on sustainable practices and equitable partnerships regarding water-resource management.

To this end, the researchers developed a web-based information system for policy-makers, researchers, governmental and 'Non-governmental organisations' (NGOs) and 'Community-based

organisations' (CBOs) to coordinate activities and strengthen collaboration among those responsible for environmental and livelihood issues in the examined water basin.

They also organised a policy workshop to fill in gaps in the database by accessing unpublished knowledge and information, to provide a forum promoting good practice and to identify future research directions.

Intrepid outcomes thus provided a framework for integrating three previously separate areas of focus to ensure future successful and equitable water-resource management in semi-arid areas of Africa. Implementing project recommendations should lead to economic development, sustenance of livelihoods and preservation of biodiversity through sustainable practices.

The Intrepid project was coordinated by the James Hutton Institute, formerly the Macaulay Land Use Research Institute, in Aberdeen, United Kingdom.

1 'Integrated trans-boundary river management policy development'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
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Traditional cereal improves quality of life

Traditional cereals comprise the staple diet of many people in rural areas of Africa. One such cereal is fonio — an indigenous plant from West Africa that is still cultivated in an enormous swathe of land that extends from Senegal to Chad.

Fonio (*Digitaria exilis*) is an important source of nutrition for several million people during the early growing season, when the main crop is still immature and alternative food resources are

scarce. Therefore, fonio consumption plays an important role in providing food security when other cereals are not available, as in the case of a failed harvest. However, scientific research into this tasty

and nutritious crop has been limited.

The goal of the EU-funded Fonio¹ project was to enhance the quality and competitiveness of the cereal

through improved production and technology and by developing both the local and export markets. The initiative involved interdisciplinary research teams from three European and four West African countries with experience in food technology, nutrition, process engineering, social sciences and agronomy. Project partners worked closely with stakeholders, including

ENVIRONMENT AND SOCIETY

producers, women's groups and small enterprises.

Scientists focused on determining the biochemical composition

of fonio and its technological, cooking and nutritional properties. Researchers strove to improve the quality of the cereal and to develop new products in order to

improve regional trade and boost export trade in fonio.

The commodity chain was also addressed at all levels, including

varieties grown, suitable farming systems and the use of post-harvest mechanisation. This enabled fonio to become a source of production diversification and higher incomes for local farmers and processors.

The Fonio project has helped to improve the quality of life for people in West Africa thanks to enhancing the quality of the cereal and increasing its competitiveness.

The Fonio project was coordinated by French agricultural research for development organisation CIRAD in Paris, France.



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1 'Unlocking the potentialities of agriculture in Africa's drylands for fighting hunger'.

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Supporting innovative agriculture in water-dry areas

Drylands are ecosystems characterised by their relative lack of water. EU-funded researchers fostered sustainable agricultural development in Africa's dryland regions via policy and funding recommendations based on previous success stories.

Drylands are often considered incapable of sustaining livelihoods. However, the African drylands population has proved remarkably resilient, with main food production coming from the cultivation of field crops and of pasture used for grazing.

Although the African economy is built on the foundation of agriculture, very little money is allocated to this sector. Given the resilience of the African drylands population together with its openness to innovation, the AIDA¹ project was designed to foster research efforts and facilitate the development of rural drylands.

The researchers sought to identify successful projects and assess the drivers behind the successes in order to develop policy recommendations and promote investment in agricultural innovations. They focused on farm household systems and farm-level activities, evaluating criteria for social, cultural, environmental and economic sustainability. Although design of a generic approach to investment in sustainable development is difficult, the researchers succeeded in creating a database of effective development projects and a template for the evaluation of future projects.

They evaluated individual case studies and tested alternative hypotheses within the involved communities using 'Participatory rural appraisal' (PRA) techniques

and on-farm trials. The AIDA project placed particular emphasis on the dissemination of project results through conferences, a dedicated website and extensive



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ENVIRONMENT AND SOCIETY

use of media coverage so as to reach the general public.

To summarise, the AIDA project resulted in a database of successful innovations in sustainable agriculture in Africa's drylands, a framework for analysing projects and prioritising

options for successful implementation, and policy briefs for fostering policy development and funding of the agricultural pillar of Africa's economy. The AIDA project should thus have significant impact on sustainable agriculture in Africa's drylands, helping to reduce poverty and

hunger in a region characterised by its resilience to drought and climate change in the face of limited budgetary allocation.

The AIDA project was coordinated by French agricultural research for development organisation CIRAD in Paris, France.

1 'Unlocking the potentialities of agriculture in Africa's drylands for fighting hunger'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
<http://cordis.europa.eu/marketplace> > search > offers > 7909



Improved resource management for better ecosystems

An EU-funded initiative has created a network of practitioners and researchers to study the governance of commons in southern Africa, targeting an improved approach to the subject for enhanced management and exploitation of natural resources.

Many southern African natural resources are legally recognised as 'commons', a term describing shared resources in which all stakeholders have equal interests. In southern Africa, the issue of their governance has received much attention from researchers as well as respective government agencies.

The Croscog¹ project was a Specific Support Action (SSA) seeking to build on and share commons governance-related research and experiences of institutions dealing with particular problems of resource management. The focus was on large-scale natural resource commons across the region's various ecosystem types. These included arid and semi-arid grasslands, savannahs and

forest patches, and marine and other large water-body coastal zones.

Recognising the need for information-sharing about effective commons governance, the EU-funded project based its work on the view that addressing natural resource degradation in Africa calls for ways of identifying, encouraging and reproducing, on a large scale, positive practices of commons management. Carried out in two thematic phases, the network of researchers and practitioners produced a series of papers based on their findings.

Papers from the first phase, with the theme of knowledge, economic transformation, power and existing commons practices,

focused on a set of specific cases each representing a particular ecosystem. The second phase, with the theme of building on existing practices to promote effective governance, included purely case-based work and comparative papers focusing on cross-case issues that emerged from discussions in the first theme. These issues included tourism, addressing historical discrimination and co-management institutions — all as related to the commons.

General project activities included workshops, networking and policy events, and specific recommendations in the form of messages to communities, non-governmental organisations (NGOs) and policy-makers. Through specific,

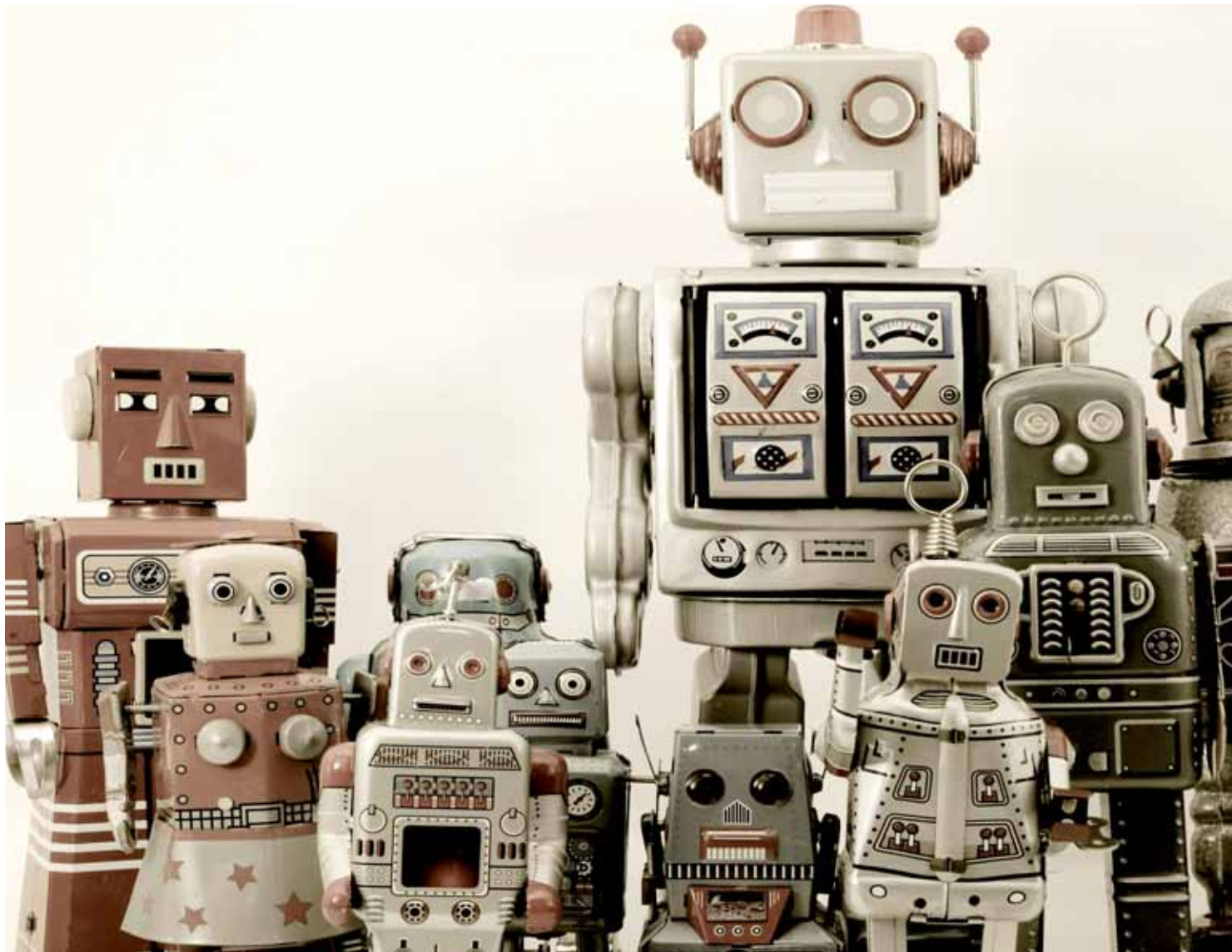
targeted-outreach and dissemination efforts, Croscog worked to share the gathered information and study results with policy-makers in southern Africa, local communities and the global scientific community, among others. The activities and their outcomes bode well for improved actions to be taken in the management and governance of commons.

The Croscog project was coordinated by the Innovative Fisheries Management research centre at Aalborg University in Aalborg, Denmark.

1 'Cross sectoral commons governance in southern Africa'.

Funded under the FP6 specific programme 'Specific measures in support of international cooperation'.
<http://cordis.europa.eu/marketplace> > search > offers > 8292





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Inspired by challenge — our robotic future

European scientists developing robots are not seeking their muse in popular culture; they look at the problems we face today and the challenges of the future, then try to build smart and intelligent technologies to combat these difficulties.

Sci-fi stories often inspire actual scientific research and achievements. Stories of aliens and spacemen exploring the universe can make a big impression on astronauts and space researchers.

We frequently see multifunctional humanoid robots like C-3PO and the Terminator in movies and on TV, but a walk through a typical robotics laboratory would rarely reveal anything even remotely human-looking. Instead, most robots are specialist machines that excel in a small number of specific tasks. Today's robots may have wheels, worm-like structures or other biologically inspired shapes.

European robotics research is looking at three areas: perception, understanding and action. Perception projects are studying how and what robots can sense in their environment. Research on understanding is discovering new ways for robots to make calculations, inferences and learn to find solutions to the tasks and problems they face. Finally, there is action — how robots respond to the world around them and perform their instructed tasks efficiently and safely.

Home from work

In some areas, such as manufacturing, the development and application of robots is already well advanced. Without robots, many

industry sectors in many higher-wage countries would be under considerable financial pressure. Indeed, sectors including micro-electronics, agro-food and automotive, which make up more than 20% of the EU's GDP and employ 25% of the workforce, could have disappeared entirely were it not for automated labourers.

Robots can even create employment. A recent study entitled 'Positive Impact of Industrial Robots on Employment' has also estimated that a million robots currently being used for industrial purposes have resulted in the development of almost 3 million jobs worldwide: from jobs created in the >

IT AND TELECOMMUNICATIONS

robotics industry itself, to employment in new manufacturing sectors enabled by industrial robots, as well as growth in the related distribution and service industries.

Research is now under way to bridge the gap between the industrial use of robots and their performance in less-controlled environments such as in the home. The Dexmart¹ project is working on this very issue, developing robots that can interact safely with humans and handle objects with skill. The project team are developing a two-armed robot which can adapt to sudden and unpredictable changes in its environment, for example to avoid bumping into people who walk in its way.

Other researchers are looking at the manipulative skills of robots and how to increase their dexterity so they can increase the number and complexity of tasks they perform. The THE² project is studying how the very nature and structure of the human hand affects the way that we learn to control and use it. The idea is to couple feedback with learning so that future robotic hands can quickly master new manipulative abilities.

Of course, humans use their hands all the time in a controlled and skilled way. But robots could still improve our accuracy in delicate, high-precision tasks such as surgery. Currently, automation is not used in the operating room for a number of technical and legal reasons, not least because life-and-death decisions on incisions cannot be left to artificial intelligence. The I-SUR³ project, however, is developing advanced technologies that will enable more automation and robotic solutions, initially for minor surgical tasks like puncturing, cutting and suturing.

Nothing routine

In all these projects, the researchers hope to develop robots that can replace or assist people with daily challenges and tasks. But there are many other important activities that humans simply cannot do. Creating machines

to extend our capabilities is another important aspect of European research.

Robots with the ability to fly are an obvious example, and there is a large volume of research going on in this area. The Airobots⁴ team, for example, is building aerial service robots. They can carry out remote inspections, for example, or support humans in a variety of situations. The robots will be able to move around freely above ground and interact safely in environments that humans could not hope to reach. Where environments are dangerous, inaccessible or perhaps particularly fragile, the robots will be able to interact non-destructively, hovering close to areas of interest and carrying out various operations, all controlled by the operator.

For advanced aerial surveillance, the SFLY⁵ project is developing a swarm of micro-flying robots that coordinate their movements to view and map an area from above. The miniature helicopters will act autonomously and carry monitoring and surveillance equipment. They will also have the ability to work out where they are in 3D space without using GPS technology. The helicopters are designed with safety in mind; they weigh only 500 g and have the ability to coordinate their flight in small swarms, even in enclosed spaces. The SFLY bots could be used for search and rescue, environmental monitoring, security surveillance, inspection and law enforcement.

Swarming behaviours are particularly attractive for robots, because swarms of simple machines can have synergistic benefits and carry out tasks that would be impossible with a single agent. Coordinated groups can provide advanced sensing capabilities and work efficiently in dangerous and challenging environments.

The SHOAL⁶ project is developing robotic fish which move by mimicking the swimming action of real fish. These robotic fish are being

developed to monitor aquatic environments and look for pollutants in water, for example to detect leaks in ports. The fish move in a coordinated shoal, to analyse contaminants and produce real-time maps of pollutant concentrations in a 3D schematic of the port.

The underwater environment is particularly challenging for humans, so a perfect opportunity for robots to demonstrate their worth. Researchers in the Trident⁷ project recognise that underwater robots could be used for a wide variety of jobs, but it is costly to develop specialist machines for every task. So they are finding ways to create multi-purpose robots which could be employed for tasks as diverse as underwater archaeology, oceanography and offshore industries. The Trident system will involve an autonomous surface craft which is linked to an underwater submersible with a robotic arm.

Whether we see swarms in the sky or find ourselves talking to a humanoid home helper, robotics are no longer limited to repetitive manufacturing monotony. European research is showing that robotics can provide highly practical solutions to today's problems.

- 1 'Dexterous and autonomous dual-arm/hand robotic manipulation with smart sensory-motor skills: A bridge from natural to artificial cognition'.
- 2 'The Hand Embodied'.
- 3 'Intelligent Surgical Robots'.
- 4 'Innovative aerial service robots for remote inspections by contact'.
- 5 'Swarm of micro flying robots'.
- 6 'Search and monitoring of Harmful contaminants, other pollutants and leaks in vessels in port using a swarm of robotic fish'.
- 7 'Marine robots and dexterous manipulation for enabling autonomous underwater multipurpose intervention missions'.

Funded under the FP7 specific programme 'Information and communication technologies' and by the Competitive and Innovation Programme's (CIP) 'ICT-Policy Support' scheme.
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One step closer to quantum computers

EU-funded researchers have developed novel ways of producing qubits that enhance their efficiency, potentially bringing the world one step closer to the 'Holy Grail' of supercomputing.

Computers based on 'Quantum bits' (qubits) rather than standard bits have the potential to perform calculations at an exponentially higher rate than that of standard computers. Quantum computers open up limitless applications to complex

numerical calculations — think of the huge difference in capability between a calculator and a computer in terms of quickly executed repetitive calculations.

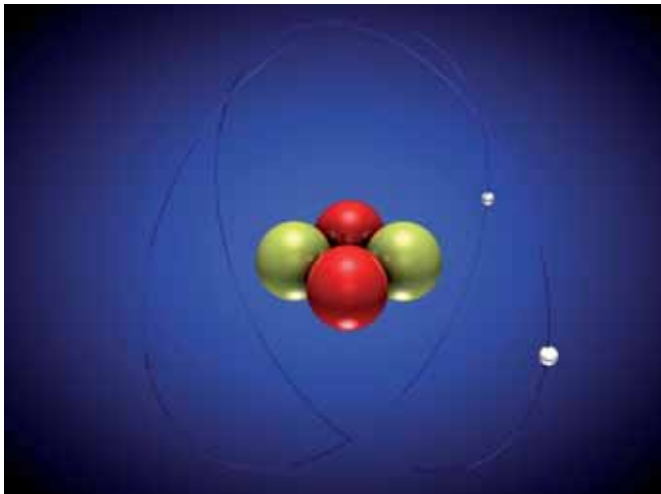
The power of qubits lies in their ability to exist in more than

one state at a given time — no more '0' or '1', now '0 and 1' is also a possibility. However, an interference phenomenon called decoherence has proved a major stumbling block to the performance required for quantum calculation. Decoherence refers

to random changes in quantum states, an instability that leads to loss of information.

Thus, the main issue in dealing with qubits is decoherence. A number of designs for qubits are based on the

IT AND TELECOMMUNICATIONS



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so-called Josephson effect in 'Low critical-temperature (Tc) superconductors' (LTSs), where the critical temperature is that at which a material becomes superconducting.

The Josephson effect, the ability of electrons to 'tunnel' through very thin non-con-

ducting regions in the absence of an applied external voltage, probably arises from incoherence of the electrons in the two superconductors separated by that region. The system of two semiconductors and the typically non-conducting space between them is the 'Josephson junction' (JJ).

European researchers supported by funding of the HYBMQC¹ project are seeking to demonstrate the feasibility of designing high-quality qubits partly based on the Josephson effect in 'High Tc superconductors' (HTSs) for intrinsic quantum protection against decoherence.

Scientists have conducted numerous experiments comparing LTS and HTS JJs. They focused on alternatives to the conventional niobium (Nb) junctions, including niobium nitride (NbN).

These junctions were characterised by 'Moderately damped regimes' (MDRs), with damping able to sustain macroscopic quantum tunnelling at lower temperatures compared to conventional JJs.

HTS JJs appeared to offer comparable functionalities to LTS JJs with more flexibility. Progress

in control of HTS JJs led to the design of an HTS quantum interference device (rf-SQUID) and the impetus for a new hybrid design and fabrication integrating indium arsenide (InAs) nanowires.

The efficiency of the qubits produced by the HYBMQC project team, using classical junction platforms, opens the way for extension to novel materials with potentially novel functions.

The HYBMQC project was coordinated by the Seconda Università degli Studi di Napoli in Naples, Italy.

1 'Macroscopic quantum dynamics and coherence in hybrid superconducting circuits for quantum computation'.

Funded by the FP7 specific programme 'People' (Marie-Curie actions). <http://cordis.europa.eu/marketplace> > search > offers > 8904

P2P comes to the rescue of Internet video

Peer-to-peer applications sometimes get a bad name because of Internet piracy. But the same technology that has long helped Internet users illegally share copyrighted music, games and videos now promises to help content providers stream video to millions of viewers simultaneously using a fraction of the bandwidth of traditional methods. The transition is being helped by EU-funded research.



© P2P-Next

Video content is the fastest growing area of the Internet. Broadcasters are offering video-on-demand and live streams over the web, Internet service providers are rolling out their own IP-based TV services, and Internet users themselves are uploading and sharing ever-more

videos via sites such as YouTube. According to some estimates, video equivalent to five years' worth of viewing time will stream across the Internet every second by 2015, accounting for more than half the world's Internet traffic. Even with new technologies providing end-users with

more bandwidth at lower cost, that is still a massive amount of data for networks to handle.

'The golden rule to remember is that all bandwidth available will be consumed,' says Jari Ahola, a project coordinator at the VTT Technical Research Centre of Finland. 'Just as bandwidth increases, the ways to consume it are increasing too: high-definition video is one example.'

The problem is due in large part to the way Internet infrastructure is designed, based on servers sending data to each client. This so-called unicast model works well for viewing a website or transferring an email, but it is simply not efficient for distributing bandwidth-hungry video content to millions of people simultaneously. More problematic still is the fact that, unlike other types of data that can be broken down into packages and transferred in almost any order, video data must be streamed sequentially for the video to be watchable.

But what if data could bypass servers entirely, hopping from one user to another? That, in essence, is what peer-to-peer (P2P) networks have long achieved. Although made famous by people using file-sharing applications to share pirated content, P2P technology has a wide range of legitimate uses, not least, in the view of Mr Ahola and others, potentially saving the Internet from video-induced congestion.

Working in the P2P-Next¹ project, Mr Ahola coordinated a consortium of 20 industrial partners, media-content providers and research institutions in the development of an innovative open source P2P video delivery platform called NextShare. Supported by EUR 14 million in funding from the European Commission, the team designed, implemented and successfully tested algorithms and protocols to use P2P architecture to stream video.

'The key difference with P2P applications for file >

IT AND TELECOMMUNICATIONS

sharing is that video data can't be broken into different packets and sent in any order; it has to be sent in sequence and maintain a certain level of quality of service,' Mr Ahola explains.

Beyond BitTorrent

The P2P-Next team initially based their system on the widely used and proven BitTorrent protocol, adapting it to handle video streams, whether video-on-demand, live webcam feeds or TV channels. Building on that research, they then developed their own open source protocol called Swift, which has been presented as a new P2P video-sharing standard.

To test their technology, the team built a web-browser plugin called Swarmplayer allowing Internet users to access Internet video via the Firefox browser, with each user acting as both a client and a server — peers — for other users. In collaboration with project partner Pioneer Digital Design, they also developed a set-top-box to show how simply and cost-effectively the system can be incorporated into consumer electronics devices.

'The set-top-box is a low-cost device that gives users access to P2P-distributed video streams on their TV via their Internet connection. It also has social networking features so, for example, users can view Twitter comment feeds about what they are watching as they watch it — something that is likely to become increasingly popular in the future,' the P2P-Next coordinator explains.

The researchers validated the system in several trials, the largest of which was conducted at the University of Lancaster in the United Kingdom, looking not just at the bandwidth savings versus other technologies, but also video quality and stability. They also showcased their set-top-box and the underlying technology at several conferences and events, including IBC 2011 in the Netherlands, where they streamed a live BBC broadcast from London using the system.

'The feedback from test users and others who have seen it in action has been very positive; most thought it was at least as good as a traditional video stream,' Mr Ahola says.

More significantly, the team found that the P2P approach slashes bandwidth demands by a minimum of 65% compared to the unicast streaming approach. It is also less demanding than multicasting — another approach to distributing video content whereby one data stream is distributed to many local servers that subsequently rebroadcast the content to local users. However, most current IP routers do not support multicasting and implementing it widely would be costly.

'For network operators, P2P offers a big advantage in terms of bandwidth demands and cost. Content providers are also interested in this technology as a low-cost alternative for their content delivery networks,' the P2P-Next coordinator says.

Providers such as the BBC and IRT/EBU were partners in the P2P-Next initiative and may look to develop commercial systems based on the technology. Meanwhile, Bitnomica, a Dutch IT spin-off from Delft University of Technology in the Netherlands, another project partner, has started to market a P2P platform based on the Swift protocol.

The technology is well matched to a content delivery environment in which the old unidirectional broadcast model is being replaced by a user-centric, time and place independent model, as people demand the ability to view, generate and share content whenever and wherever they like, using a range of heterogeneous devices.

'By developing these open source protocols and algorithms, we've laid the groundwork for others to follow and develop their own applications. I would not be surprised to see P2P video streaming becoming much more widespread in the future,' Mr Ahola concludes.

The P2P-Next project was coordinated by a European consortium of 21 partners from 12 countries.

1 'Next generation peer-to-peer content delivery platform'.

Funded under the FP7 specific programme 'Cooperation' theme 'Information and communication technologies'.
[http://cordis.europa.eu/marketplace >](http://cordis.europa.eu/marketplace/search)
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Software development gets easier

New tools to support software engineering based on aspect-oriented programming will make it easier to break down mammoth programming tasks and overcome challenges.



Software systems are becoming larger and more complex, requiring increasingly sophisticated solutions to facilitate software engineering. The EU-funded RIVAR¹ project developed novel approaches that divide challenges into parts and recombine partial solutions within integrated modular systems.

It examined these challenges through 'Aspect-oriented programming' (AOP), considering various modularisation strategies that enable programmers to effectively maintain modularisation hierarchies in parallel and combine them to produce one whole system.

To achieve its aims, RIVAR investigated the source code of three large aspect-based

IT AND TELECOMMUNICATIONS

systems, documenting specific assumptions made by their developers. It then catalogued them in a single publication that can be used for assumption elicitation in code walkthroughs, among other uses. The ensuing catalogue of aspect assumption types was published at the International Conference on Aspect-Oriented Software

Development, 2011, focusing specifically on the AspectJ language.

In addition, the project developed templates of formal expressions of the assumption types for verifying that an aspect's assumptions can be easily integrated into a base system. Aspect developers can use these

templates to help facilitate different key elements of software engineering. Many of the tools to help this endeavour have been published on the project website, which features published papers, relevant data and other resources.

The RIVAR project was coordinated by the Computing

Department at Lancaster University in Lancaster, United Kingdom.

1 'Rich interfaces for verifiable aspect reuse'.

Funded under the FP7 specific programme 'People'.
<http://cordis.europa.eu/marketplace> >
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New optical sensor can 'see' dangerous chemicals

EU-funded researchers have developed an optical solution to identify chemical and gaseous dangers that is safer, easier to install and, unexpectedly, much more sensitive than most existing chemical sensors.



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Electricity and some gases and liquids can be a dangerous — even explosive — combination. But sensors are still needed in harsh gaseous and liquid environments, whether to check for leaking hydrogen fuel cells or to measure the composition or acidity of industrial chemicals.

Developed in the Dotsense¹ project, the sensors are based on an innovative application of quantum dots and nanowires — minuscule semiconductors whose features are thousands of times smaller than the width of a human hair. Made of the group

III-nitride semiconductor system — (Al,In)GaN — chemically stable semiconductor materials with excellent opto-electronic properties, these structures show changes in their photoluminescence properties when exposed to even the smallest changes in the chemical environment.

'To date, many approaches have been adopted for sensing technology, including, for example, using nanowires as chemical sensors, but these approaches are based on measuring electrical conductivity. This means you have to put in electrical

contacts and measure the change in the electrical resistance of the nanowire in different chemical environments,' explains Dr Martin Eickhoff, the Dotsense project coordinator at Justus-Liebig-University in Giessen, Germany. 'With our approach, that's unnecessary. Our solution is based on a completely optical analysis.'

Instead of running an electrical current through the nanostructures and measuring the resistance, the Dotsense team created an integrated sensor system that works solely with light.

An optical transducer, made of an array of a billion GaN or InGaN 'quantum dots' or 'nanodisks' in nanowires, is placed inside the gaseous or liquid environment that is to be monitored and an excitation light is shone through a transparent substrate that simultaneously serves as a sealing window. The photoluminescence properties of the nanostructures change depending on which chemicals are present in the environment being monitored, hence varying the intensity of the light emitted from the transducer. The change can then be read out using commercially available photo-detectors.

'We take advantage of the chemical sensitivity and the high surface-to-volume ratio of the nanostructures without having to implement a more complicated processing technology — there's a lot less technological effort involved to deploy and use this kind of sensing system,' Dr Eickhoff notes.

The approach has numerous advantages. It is less complex, as only light is involved and there is no need for electrical contacts and measuring systems. The sensors require much lower operation temperatures compared to conventional sensor systems. And, because light — and not electricity — is all that is passing through the environment being monitored, it is much safer, particularly in cases where the gas or liquid is flammable, pressurised or explosive.



IT AND TELECOMMUNICATIONS

EADS Innovation Works, a member of the Dotsense consortium, is interested in using opto-chemical sensor technology in aerospace applications, for example, where safety and robustness are major concerns.

‘On an aircraft, they could be used to monitor water quality, hydraulic fluid, gas leaks or fuel,’ Dr Eickhoff notes. ‘When we started the project, aeronautical applications were our main focus, but we soon realised that there are additional applications for this technology in many other industries.’

More sensitive than electrical sensors

Although the primary goal of the Dotsense project, supported by EUR 1.2 million in funding from the European Commission, was to develop chemical sensors that do not require electrical contacts, the team found that in several cases their all-optical solution

is actually much more sensitive than electrical equivalents.

‘The idea was not to make a highly sensitive device, but in the end it turned out that these optical nanostructures can actually be much more sensitive than electrical sensors,’ Dr Eickhoff says. ‘It was certainly something we hoped might be the case, but we couldn’t be certain until we conducted tests. Combined with their other advantages, that opens up a whole range of uses.’

He points, for example, to gas detection in industrial environments or home smoke alarms, to health-care applications and to uses in the food-processing industry to test the composition of liquids.

‘There are many applications for these sorts of sensors. In fact, a lot of industrial sectors like the idea that you don’t need electrical components and an

electrical current running in the medium in which you are operating — the key benefits of this are safety and reliability,’ the Dotsense coordinator explains.

Nonetheless, the technology remains some way away from commercial use. The Dotsense team overcame key technical challenges, such as pushing the emitted light from the transducers into the visible range so it can be excited by LEDs and detected with relatively inexpensive commercial photo-detectors, controlling the growth of the nanostructures, and understanding the photo-electrical processes that occur on the surface of the nanostructures in different chemical environments. But more research is needed, Dr Eickhoff notes.

Partly with that goal in mind, members of the team have launched a national follow-up project called ‘Sinomics’ in which they will integrate LEDs and

photo-detectors with nanostructures on-chip to develop innovative devices for gas sensing and detection.

‘I’m optimistic that over the coming years this technology will find several applications, and it will become cheaper and hence more commercially viable to start producing all-optical sensors,’ Dr Eickhoff says.

The Dotsense project was coordinated by researchers at the Justus-Liebig-University in Giessen, Germany.

1 ‘Group III-nitride quantum dots as optical transducers for chemical sensors’.

Funded under the FP7 specific programme ‘Cooperation’ under the theme ‘Information and communication technologies’.
<http://cordis.europa.eu/marketplace/search/offers/8608>

Shedding light on experimental physics

Accurate phase measurement in experimental physics has come of age, thanks to high-tech advances in broadband-squeezed light.



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Precision experimental physics depends on accurate phase measurement, which has been an elusive objective in research circles. The EU-funded Precision DC LIGHT¹ project is working on overcoming this limitation.

The project is aiming to achieve what is known as the

Heisenberg limit for precise measurement of optical phase, considered the Holy Grail of quantum measurement. It is exploiting non-classical (phase-squeezed) states of light with inherent quantum correlations, using broadband-squeezed light produced by broadband parametric ‘down conversion’ (DC)

that is pumped by a narrow-band laser.

Project researchers have been working on generating and detecting correlated quantum states by exploring new avenues to super-resolved phase measurement. The scientists are attempting to achieve sub-shot noise phase measurement using ‘precision DC’ (PDC) as the source for broadband quantum squeezing and ‘Sum-frequency generation’ (SFG) as the ultra-fast detector of this squeezing.

In parallel, the project is working on a high-power broadband ‘Optical parametric oscillator’ (OPO) and on optimising its performance to use in applications such as spread spectrum optical communication.

After extensive testing, the project team made significant

progress in achieving its objectives. It successfully demonstrated a source of an ultra-high flux of entangled photon pairs and generated correlated fields by broadband FWM. Moreover, it conducted an analysis of SFG as an ultra-fast detector of squeezing and established a detailed simulation of OPO source for high-power broadband PDC.

The success achieved so far is on track to helping European researchers advance precision experimental physics and position Europe as a leader in the field.

This project was coordinated by the research authority at Bar Ilan University in Ramat Gan, Israel.

1 ‘Precision measurement beyond the classical limit with novel sources of broadband squeezed light’.

Funded by the FP7 specific programme ‘People’ (Marie-Curie actions).
<http://cordis.europa.eu/marketplace/search/offers/8778>

Communicate with the future

An EU-funded project has developed a computer framework that ensures we will always be able to use data, however and wherever it is saved and stored.

Do you hate it when you try to open a computer file and up pops a box which says 'Invalid file format'? Or when vendors of software and operating systems announce they will no longer support and update legacy systems?

Data formats, ICT hardware, software and protocols are constantly evolving. But even as we gather and manipulate so much data, could it be lost just because its format is old or hardware has changed? The prosperity of future generations relies on their access to the information of the past. Are our descendants at risk of knowing nothing because everything we know today is locked in computer systems and codes that one day may be impossible to crack?

A framework for development

The EU-funded Shaman¹ project has developed a framework that makes 'digital preservation' (DP) a reality for virtually any data format. People will be able to store and archive digital objects and information in confidence, knowing that they will be fully accessible and useable in

the future, whatever the future brings. 'Shaman has developed new technologies which could enable us to communicate with the future, securing the valuable digital we are creating today. They will be readable, accessible and usable for future generations,' remarks Ruben Riestra, the project's coordinator.

'Contrary to the general idea that "digital lasts forever", the risks of losing digital content related to obsolescence of hardware and software should not be underestimated, and can create considerable damage to valuable information assets,' he continues. 'The fast pace of development of digital information isn't necessarily reflected in other areas; for example, the Airbus A380 will be operational for some decades and therefore the digital documentation of aeroplane maintenance must be stored, secured and easily accessed for perhaps the next 40 to 50 years.'

A holistic solution

The 'Shaman reference architecture' (SRA) provides a unified view of digital preservation, approaching the problem from a holistic perspective. The SRA

enables digital preservation to be integrated seamlessly into the overall architecture of an organisation.

The development of the framework required the project partners to explore current DP practices and create an architecture that was not limited to a specific DP methodology. By looking at the specific concerns expressed by those using current digital preservation methods in a variety of organisations, the Shaman team was able to produce a solution which makes this straightforward for organisations for whom preserving content is not necessarily their primary business requirement, but is nevertheless important for future success.

The Shaman framework includes tools for analysing, managing, accessing and reusing information objects and data across various libraries and archives. It supports the preservation of information, and the specific applications and services that could be applied to the data, all in ways that future technologies and systems will be able to understand and execute.

For example, if you want to preserve animation files you cannot simply store a video; it is also important that you can apply or reapply post-production processes (such as colour transformations) to individual frames of the video. The Shaman reference architecture makes this possible.

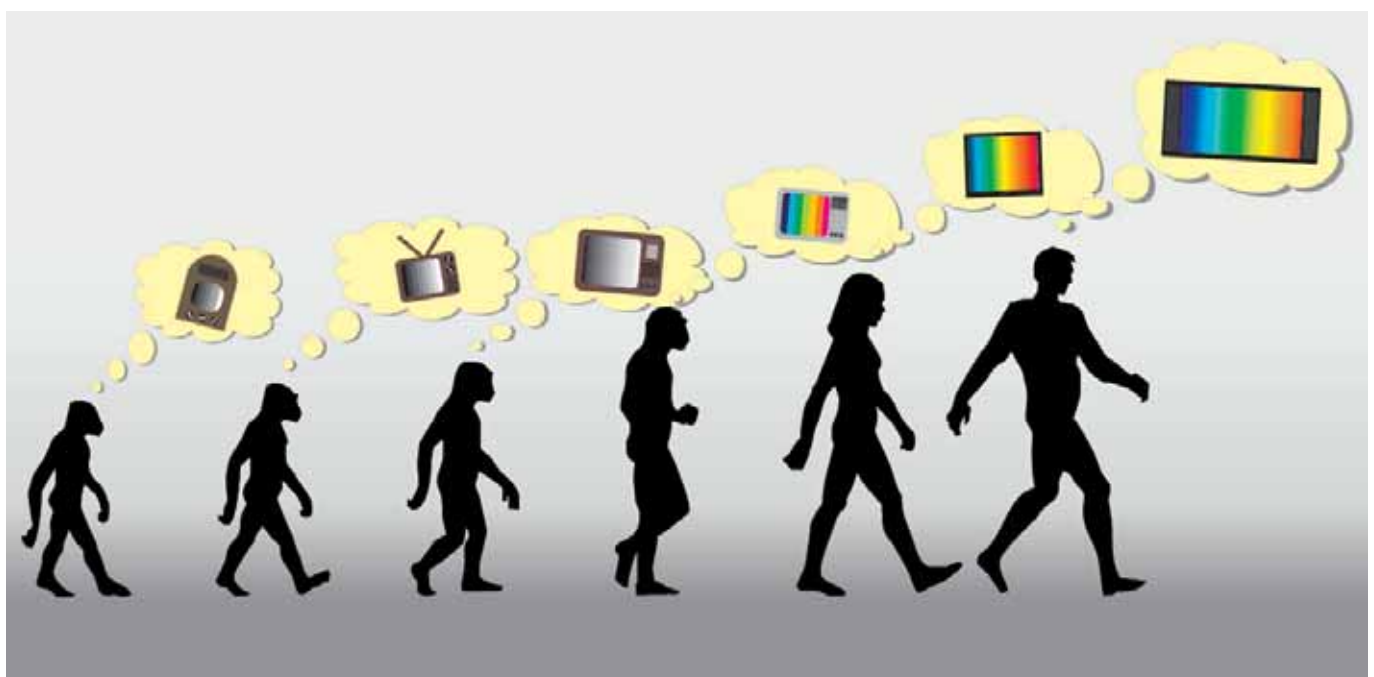
Beyond the cloud

The architecture also goes beyond simple cloud storage solutions. As Mr Riestra explains, 'the most important difference is the time frame: storage in the cloud is mainly for short term, while digital preservation is related to issues such as multiple migrations over time, hardware and mainly software obsolescence.'

The cloud currently consists of a wide variety of services, solutions, platforms and technologies, all in their early stages. 'Putting digital content on the cloud is still a risk,' Mr Riestra suggests. 'Instead, we need robust, long-term solutions that can secure data and metadata in many formats for the future.'

Prototype applications

The Shaman project produced three prototype applications, designed to demonstrate the validity of



IT AND TELECOMMUNICATIONS

the framework and to showcase some exemplary tools developed using the reference architecture.

The first prototype, developed in association with the German National Library, successfully demonstrated that the complete digital lifecycle (creation, assembly, archival, adoption and reuse) could be applied to books and associated material (such as documents, slides and videos). The project showed how complete information, including structural metadata and data on the creation context, could be applied. Furthermore, certain archival functionality, such as migration of image formats from TIFF to JPEG, could be carried out with high-quality assurance.

The second prototype applied the Shaman framework's concepts to industry, aiming to increase

efficiency, ensure legal compliance and improving back-up times. 'In industry, digital preservation is still not widely accepted and has different requirements, often driven by legislative rules. Trust, authenticity and access rights also shape the solutions currently on offer and in development,' explains Mr Riestra. 'The prototype demonstrated successful integration of a product lifecycle management system, with digital preservation built in, based on a consumer electronics test case.'

The third prototype looked at the science sector, an area that continuously generates and needs to manage a large volume of data. 'We set up three scenarios: we wanted to demonstrate how it was possible to capture and preserve sensor data from civil engineering (dam safety), scientific

workflows and experimental data in particle physics,' says Mr Riestra. 'In these areas, a large amount of complicated data in many different formats needs to be stored, managed and reused and the Shaman infrastructure was able to deal with this effectively, further demonstrating its flexibility.'

The project has already contributed to preserving digital information for future reference by a variety of organisations, including universities, engineering firms, technology spin-outs and national libraries. By developing a holistic solution, designed to provide multiple benefits to organisations, Shaman has developed an architecture which makes DP easy and attractive. Hopefully, those annoying error boxes will be a thing of the past (and probably one of the

few things we may not want to preserve).

The Shaman project received EUR 8.4 million (of the total EUR 12.29 million project budget) in research funding. It was coordinated by INMARK Studies and Strategies (IEE) in Madrid, Spain.

1 'Sustaining heritage access through multivalent archiving'.

Funded by the FP7 specific programme 'Cooperation' under the theme 'Information and communication technologies'.
<http://cordis.europa.eu/marketplace/search/offers/8827>

Stimulating communication, preventing selfish behaviour

Individuals' mobile networks offer the prospect of enhanced communication, but also raise questions regarding their potential for dangerous use. A European research project is addressing relevant concerns in the hopes of promoting ongoing development of supporting technologies.



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The advent of mobile communication devices able to directly link to each other using short-range communication technologies (such as Bluetooth or Wi-Fi)

can be applied to the development of completely distributed, infrastructure-less networks. These so-called mobile networks of individuals offer the potential

to relay information for enhanced personal experiences, and are useful in the case of emergencies or disasters.

However, this exciting and revolutionary technology raises critical issues related to user behaviour and security, given the unavoidable reality of ill-intentioned behaviour as an unavoidable part of human nature. As such, individuals — the carriers of these devices, or nodes — may be hesitant to embrace the technology and benefit from its potential, which will in turn have a negative impact on its scientific and industrial development.

The Rational¹ project has been established to address such concerns. It advances mechanisms or tools critical to constructing secure distributed systems, thereby addressing so-called selfish-node behaviour. The EU-funded project is focused on

building primitives for forwarding and reliable broadcast in mobile networks of people, building protocols for consensus in a mutually suspicious domain, and better understanding the impact of 'selfishness with outsiders'.

Work to date has been presented in leading conferences, and several submissions have been made for future participation as well as paper publications. Ongoing efforts and contributions to the field of study of distributed systems promises to advance the tremendous potential of this technology for the benefit of society at large.

The Rational project was coordinated by researchers at the Sapienza University of Rome in Italy.

1 'Rational: Secure mobile networks of selfish individuals'.

Funded by the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace/search/offers/8866>



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Europeans push the bio-nano-technology envelope

Researchers in Germany have once again made a major breakthrough in bio-nano-technology, this time in the area of solid-state nanopore sensors, enhancing their capabilities by fitting them with cover plates made of deoxyribonucleic acid (DNA).

This major advance was made in part thanks to the DNA Origami Devices¹ project, which received a European Research Council (ERC) grant worth EUR 1.5 million under the EU's Seventh Framework Programme (FP7). This project has opened up novel opportunities for a systematic study of macromolecular interactions in biology and is likely to deepen our understanding of regulatory processes in biology. The findings of this latest study were presented in the journal *Angewandte Chemie International Edition*.

Anything in the nanoscale refers to something so small that it can only be measured in the billionth. In this case, nanopores are very small holes, usually in synthetic materials like graphene or silicone, and are used to analyse and sequence single nucleic acid molecules. Nanopore biotechnology offers one of

the most promising approaches to single molecule detection and analysis.

What the researchers at the Technische Universitaet Muenchen (TUM) in Germany have achieved is enhancing the ability of solid-state nanopores by fitting them with cover plates made of DNA. These nanoscale cover plates, which have had central apertures tailored to various 'gatekeeper' functions, are formed by so-called DNA origami. This is the art of making structures from DNA to fold into custom-designed structures with specified chemical properties. This represents a major breakthrough for the industry as a whole with far-reaching effects.

This achievement did not come easy and is the result of hard work by different teams over recent years. One team led by TUM's Professor Hendrik Dietz focused its efforts on

refining control over DNA origami techniques and demonstrating how structures made in this manner can enable scientific investigations in diverse fields. Another research team at TUM, led by Dr Ulrich Rant, was doing the same but in the field of solid-state nanopore sensors, where the basic working principle is to urge biomolecules of interest, one at a time, through a nanometre-scale hole in a thin slab of semiconductor material. When biomolecules pass through or linger in such a sensor, minute changes in electrical current flowing through the nanopore translate into information about their identity and physical properties.

By working together they were able to develop a new device concept which until now had been purely hypothetical; this involved the placement of a DNA origami nanoplate over the narrow end of a conically >

INDUSTRIAL TECHNOLOGIES

tapered solid-state nanopore. By adjusting or 'tuning' the size of the central aperture in the DNA nanoplate, they could filter the type of molecules that pass through according to size. Furthermore, by placing a single-stranded DNA receptor in the aperture as 'bait', they should enable sequence-specific detection of 'prey' molecules. In principle, such a device could even serve as the basis of a novel DNA-sequencing system.

'We're especially excited about the selective potential of the bait/prey approach to single-molecule sensing,' said Prof. Dietz, 'because

many different chemical components beyond DNA could be attached to the appropriate site on a DNA nanoplate.'

High-resolution sensing applications, such as DNA sequencing, will face some additional hurdles, however, as Dr Rant explained: 'By design, the nanopores and their DNA origami gatekeepers allow small ions to pass through. For some conceivable applications, that becomes an unwanted leakage current that would have to be reduced, along with the magnitude of current fluctuations.'

This project was coordinated by researchers at the Munich Institute of Technology in Munich, Germany.

1 'Single-molecule studies of protein-protein-DNA interactions, enabled by DNA origami'.

Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 24973

Enhanced efficiency of nickel mining

Our earth is a storehouse, a virtual treasure trove of useful substances that nature provides and which are extracted in various ways and forms. EU-funded researchers are collecting mineralogical data to enhance the widespread and efficient use of a simple and cost-effective nickel-mining process.

Nickel is an important alloying element used to make steel for construction and high-quality cutlery. Ores are typically either sulphide or laterite, where the former is deeper, higher grade, expensive to mine and requires practices of questionable environmental impact. Laterites account for about 70% of the world's nickel resources and laterite processing is predicted to be the mining method of choice in the future.

Superficial lateritic nickel ore deposits are typically formed in hot, wet tropical areas by chemical 'weathering' of the underlying

rock. This weathering, or breaking down of the rocks and soil through contact with air and water, results in a broad spectrum of soil types and mineral contents depending on the parent material.

EU-funded researchers working on the NICAL¹ project are investigating the compositions of several laterite deposits in an effort to enhance their mining by cost-effective 'Atmospheric heap-leaching' (AHL) methods. They also aim to define criteria for the identification of future oxide-rich nickel-laterite resources suitable for AHL.

AHL differs significantly from traditional *in situ* mining processes. A 'heap' of crushed ore is placed on a liner and leach chemicals percolate through it (at atmospheric or environmental pressure, but no special high-pressure equipment). This ensures that valuable materials end up in the leachate for processing.

The consortium first carried out geological and mineralogical studies employing advanced imaging techniques at three sites (Albania, the Philippines and Turkey) to identify soil compositions, porosity and the like.

They then conducted AHL experiments, sampling products at regular intervals during the process. Data was fed into the metallurgical-modelling programme Metsim to enhance future predictive power.

Although ongoing, experiments have already demonstrated several mineral phases previously not seen in bulk tests that will prove useful in optimising AHL of nickel and retention of soluble nickel in the leachate.

Continuing work will focus on the combined use of X-ray fluorescence and X-ray diffraction, with promising preliminary results to date.

The project was coordinated by researchers at the Natural History Museum in London, United Kingdom.



1 'Atmospheric heap-leaching to solve nickel laterite processing problems'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8819

Enhancing quality control in aeronautics

The manufacturing industry relies heavily on precise measurement during assembly and inspection. New optical-sensor technology and image-processing algorithms, developed by EU-funded research, can enhance speed and accuracy while reducing manufacturing costs.



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In the aeronautics industry, metrology faces certain difficulties related to the combination of manufacturing very large and highly reflective parts together with the need for extreme precision and accuracy.

Conventional methods employ very large frames capable of holding both the parts and the manual measurement instruments. Inspection is thus both labour- and time-intensive, both of which significantly increase manufacturing costs.

European researchers initiated the Ipromes¹ project to develop optical-image processing techniques for assembly-phase

positioning as well as final-product measurement.

The consortium developed an optical sensor with robust image-processing algorithms suited to aeronautical components. Such structures exhibit highly reflective surfaces, curved and sharply cut edges and various hole shapes.

The Ipromes sensor exhibited increased accuracy via implementation of a structured light algorithm capable of handling various ambient illuminations. In addition, the sensor and processing software were quite flexible and user-friendly. The system had the ability to repeatedly measure any arbitrary shape without restriction by employing

a user-defined frame-of-reference based on measured data.

Ipromes technology should speed up the inspection process while increasing accuracy of measurements, leading to important cost reductions and enhanced quality within the aeronautics sector. Further enhancements in accuracy, as well as implementation of wireless PC control, have the potential to extend applications to many other manufacturing sectors.

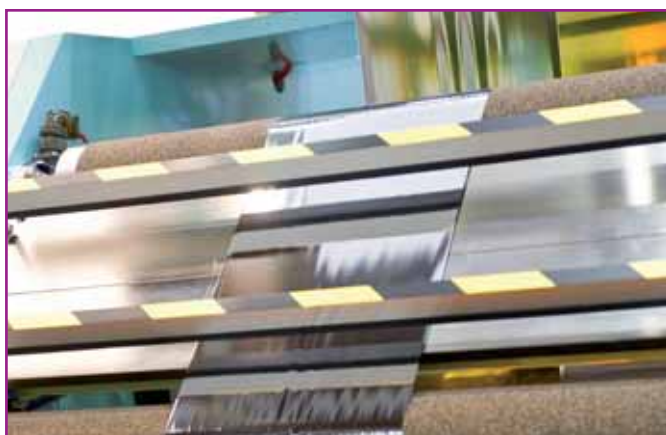
The project was coordinated by the Alma Consulting Group, based in France.

1 'Using image processing as a metrological solution'.

Funded by the FP6 specific programme 'Aeronautics and space'.
[http://cordis.europa.eu/marketplace > search > offers > 8952](http://cordis.europa.eu/marketplace/search)

Rational design of stretched plastic packaging

Virtually every home recycling container or bin can attest to the ubiquitous use of plastic packaging materials. EU-funded researchers evaluated a variety of materials and processing methods that should advance the design of new products.



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Careful scientific development of new packaging products and processing procedures based on the relationship between the structure of polymers and their resulting properties is lacking.

European researchers seek to develop a global strategy

for scientific optimisation of stretched plastic packaging initiated the APT-PACK¹ project.

Scientists focused on three types of polymers relevant to stretched plastic packaging (amorphous, semi-crystalline and amorphous that crystallises during forming)

and the two conventional processing methods, thermoforming and stretch blow moulding.

They sought to elucidate correlations between polymer structures and end-use properties. Thus, they studied evolution of microstructure during processing with a special focus on the rheology (flow properties) of the polymers.

Experimentally, scientists developed high-velocity loading tests for thermoforming and stretch blow moulding. They advanced knowledge related to microstructure development as well as heating, stretching and cooling. Results contributed to the formation of a database on heating, thermal contact, loading histories and friction during processing.

Data has helped to define and propose relevant models as well as to focus future numerical codes for rational design. Overall, APT-PACK advanced scientific knowledge and understanding of the correlation among polymer materials, processing methods and conditions, and final end-user product properties that should advance the global stretched plastic packaging market.

The project was coordinated by the Association pour la Recherche et le Développement des Méthodes et Processus Industriels- Ecole Nationale Supérieure des Mines de Paris, in France.

1 'Advanced knowledge of polymer deformation for tomorrow's packaging'.

Funded by the FP6 specific programme 'Nanotechnologies and Nano-sciences' (NMP).
[http://cordis.europa.eu/marketplace > search > offers > 8948](http://cordis.europa.eu/marketplace/search)

INDUSTRIAL TECHNOLOGIES

Multi-functional decorative coatings for electronics

EU-funded researchers have developed a new class of thin-film coatings with a huge spectrum of mechanical, optical and electrical properties. Tailor-made combinations of properties should make the coatings a winner with the consumer electronics sector.



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Thin-film coatings are widely used throughout the medical, automotive and machine tools industries. They provide additional resistance to a number of conditions detrimental to the life and function of components.

Thin-film coatings are also important to the electronics and optics industries. They play a major role in the semiconductor sector and in electrical connections on circuit boards. Optical

coatings are applied to everything from household mirrors to photovoltaic (PV) cells.

More recently, decorative thin-film coatings in a wide range of colours have made consumer electronics a bit more attractive than black, white and silver.

European researchers set out to develop new coatings for decorative and micro-optoelectronics applications via the Hardecoat¹ project.

Scientists developed a new range of coatings, transition metal oxynitrides (TM-O-N), combining the strength of nitrides with the colours attainable using oxides. In addition, transition metals have interesting electrochromic properties, or the ability to change their optical properties in response to a small voltage in applications such as 'smart' windows or X-ray mirrors. As metals, they also can act as conductors or semiconductors.

Integrating all these potential characteristics in one class of compounds and exploring the vast spectrum of possible combinations was the goal of the Hardecoat project.

In addition, investigators opted to modify the physical vapour deposition (PVD) method, specifically reactive sputtering, for deposition of the novel coatings. PVD produces much less negative environmental impact than conventional electroplating or chemical-vapour deposition methods that use toxic chemicals

and produce a large volume of waste.

Four modified reactive sputtering processes were developed for TM-O-N thin-film deposition. Coatings demonstrated a range of colours, optical and electrical properties as well as excellent resistance to corrosion and wear.

Hardecoat coatings, with their rich spectrum of tuneable properties, should make a significant impact on the decorative, optoelectronic and micro-technology sectors. In addition, the cost-effective and environmentally friendly deposition processes should be welcomed by manufacturers and consumers alike.

The project was coordinated by the École Nationale Supérieure de Mécanique et des Microtechniques de Besançon, France.

- 1 'Development of new hard decorative coatings based on transition metal oxynitrides'.

Funded by the FP6 specific programme 'Nanotechnologies and Nano-sciences' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 9038

Using nature's cue to make complex natural products

This EU-funded project investigated novel chemical synthesis methods mimicking nature's efficiency to develop a library of simple precursor molecules capable of one-step functionalisation, yielding complex bioactive natural products.

Chiral molecules are abundant in living organisms. Examples include DNA, enzymes, antibodies and hormones. These molecules exist as pairs of mirror-image molecules known as enantiomers that are not superimposable.

Most drugs are also chiral molecules. The two enantiomers typically have different activities. In the best case, where one

form is benign, non-selective synthesis leads to decreased production efficiency, increased cost and the need to dispose of unwanted compounds. In the worst case, where one form is harmful although the other is beneficial, lack of specificity in synthesis can have devastating results. Thus, the synthesis of pure enantiomers (asymmetric synthesis) has become increasingly important.



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Equally important to the commercial applicability of

synthesis reactions is the use of a catalyst that speeds up the

INDUSTRIAL TECHNOLOGIES

rate of the chemical reaction without itself being altered — the catalyst is used again and again and the product is quickly amplified.

In 2001, the Nobel Prize in chemistry went to scientists who developed catalytic asymmetric synthesis methods employing a single enantioselective chiral catalyst to produce millions of pure chiral products.

Since then, researchers have tried to mimic biology and develop asymmetric catalytic

methods to build architecturally complex molecules, but results have generally lacked the efficiency and flexibility of nature.

EU-funded researchers working on the CED¹ project set out to develop a novel asymmetric catalytic technique for chemical synthesis based on one-step conversion of a common functional block to a wide variety of enantio-pure natural products.

Scientists focused on development of a 'Catalytic enantioselective dearomatisation' (CED) process, essentially converting

flat aromatic rings into complex asymmetric molecules. In addition, they sought to improve synthesis of a model compound and investigate a variation on CED called the zipper reaction in which a linear (rather than circular) precursor is used.

The search for simple molecules to act as precursors to complex biologically active molecules via simple catalytic processes should lead to the creation of a novel library of small molecules with untapped biological capabilities. Project results could thus have significant impact on the cost-effective and

efficient industrial synthesis of important enantio-pure molecules.

The project was coordinated by researchers at the University of Cambridge in Cambridge, United Kingdom.

1 'Catalytic enantio-selective dearomatisation'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).
<http://cordis.europa.eu/marketplace> > search > offers > 8812

Magnetic refrigerators

Molecular magnets, gaining widespread attention as the potential building blocks of tomorrow's spintronics-based quantum computers, are also being evaluated for their unique properties related to magnetic refrigeration. EU-funded researchers investigated the role of specific metal cores in complex chemical molecules in cooling.

The magnetocaloric effect (MCE) refers to a reversible change in temperature of a material induced by exposure to a changing magnetic field. It is particularly prominent in the chemical element gadolinium (Gd), from the lanthanide (4f) series of the periodic table.

Recent work supports a role of so-called 3d-4f complexes (referring to electron subshells or orbitals of 3d transition metals and 4f lanthanides) in magnetic cooling effects.

European researchers sought to investigate 3d-4f complexes in structures consisting of two anti-ferromagnetic rings capable of aligning magnetic poles and their potential as 'magnetic coolers' via EU-funding of the Linkrings¹ project.

The magnetic properties of several 3d-4f complexes based on the transition element cobalt (Co) and the lanthanide series, including Gd, were first prepared and then studied.

The maximum MCE was produced by the Gd derivative in each family

of complexes tested. The change in entropy (a measure of heat absorption) was proportional to the percentage of Gd in the core of the complex supporting its critical role in molecular temperature modulation via magnetic manipulation.

Heat-capacity measurements (indicating the amount of heat required to change the temperature of the material by a certain amount, or intuitively the amount of heat it can store before changing temperature) supported results of magnetic analyses, suggesting that the Co-Gd family is an excellent magnetic cooler.

Thus, project work confirmed the importance of 3d-4f complexes in magnetic cooling via the MCE and also highlighted the relationship between the size of the MCE effect and the percentage of Gd in the core of the linked-ring complex.

The Linkrings project successfully advanced molecular magnet research with a focus on magnetic coolers. Future magnetic refrigeration would eliminate the need for hazardous coolants as well as reduce energy



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consumption, providing a new range of environmentally friendly refrigerators.

The Linkrings project was coordinated by researchers at the University of Manchester in the United Kingdom.

1 'Linking rings into complex structures'.

Funded by the FP7 specific programme 'People'.
<http://cordis.europa.eu/marketplace> > search > offers > 8762

INDUSTRIAL TECHNOLOGIES

Environmentally friendly catalyst for industrial use

Catalysts are compounds that speed the rate of chemical reactions without themselves being altered by the reaction. Thus, they can be used again and again.

Oxidation catalysis of organic substrates is a main field of research, given that oxidation, typically mediated by a transition-metallic compound and using hydrocarbons (organic

compounds) as a feedstock, is a common step in the production of commodity and fine chemicals.

Metal complexes can activate molecular oxygen (O_2 or dioxygen) for catalytic oxidations. Although iron and copper systems have been studied extensively, other metal complexes have not.

Studying the ability of nickel (Ni) to activate molecular oxygen and of the catalytic potential of the resulting Ni- O_2 species toward organic substrates was the motivation for the EU-funded Ni O_2 activation¹ project.

Researchers focused on an isolatable and thermally stable superoxo compound, [NiII(beta-diketiminato)(O_2)] (LNi O_2).

LNi O_2 showed unprecedented dioxygenase-like activity in the oxidation of 2,4,6-tri-tert-butylphenol, an industrial chemical used as a fuel, oil, gasoline or lubricant additive. No example of such a reaction appears in the literature, and it appears to be specific to Ni as copper- and cobalt-based metal superoxo

compounds do not exhibit this behaviour.

In addition, scientists found that LNi O_2 interacted with an iron(II) complex to form a highly reactive compound with a Ni O_2 Fe core exhibiting mono-oxygenase activity.

Ni O_2 activation¹ project results supported the powerful oxidising potential of Ni-dioxygen compounds and their viability as environmentally friendly alternatives to heavy metal counterparts palladium and platinum for use in industrially relevant oxidation catalysis reactions.

The Ni O_2 activation project was coordinated by researchers at the Berlin Institute of Technology in Berlin, Germany.

1 ¹ O_2 -Activation at nickel complexes and their use as catalysts for environmentally friendly oxidation technologies!

Funded by the FP6 specific programme 'Nanotechnologies and Nano-sciences' (NMP).
<http://cordis.europa.eu/marketplace> > search > offers > 8646



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Novel ceramic materials and processes

Development by EU-funded researchers of novel nano-composite ceramics and adaptation of a high-accuracy metal-machining process for complex geometries has the potential to broaden the applicability of ceramics.

Ceramics as a class of materials include much more than the traditional ceramic clay with which we are all familiar. In addition to silicate glass and cement, the vast array of advanced ceramics has found widespread application in fields as diverse as aerospace, medical, military and communications devices.

Ceramics provide many advantages over other materials due to their high wear-and-corrosion resistance combined with low density. Furthermore, their raw

materials are abundantly available at a low cost. Most ceramics are produced by powder metallurgy which leads to the need for post-processing in more than half of the components.

Adapting an existing metal-machining process for use with ceramics and thus enhancing the potential market for ceramics was the goal of the Moncerat¹ project.

'Electrical discharge machining' (EDM) is a process used for



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machining hard metals that is restricted to electrically conductive materials. Despite this

limitation, it enables accurate production of small and odd-shaped parts.

INDUSTRIAL TECHNOLOGIES

Application of EDM to ceramic parts required development of novel electro-conductive ceramic materials combined with an integration of the EDM process technology adapted for ceramics.

With the advent of nanotechnology, researchers have found that nanopowders consisting of particles on the scale of atoms or molecules enhance the mechanical properties of the ceramic products in which they are incorporated.

Moncerat researchers synthesised novel high-quality nanopowders using 'Self-propagating high-temperature synthesis' (SHS). As a result, new ceramic composite materials including nanocomposites, were developed. Investigation of the effects of ceramic material microstructure on the EDM process led to integration of process effects into the materials design phase.

Commercial exploitation of Moncerat results is expected to

facilitate a shift from the use of classic materials to ceramics, which often exhibit superior properties and can now be produced more effectively. Broadening the potential market for ceramics should provide a boost to the ceramics industry and the EU economy.

The Moncerat project was coordinated by researchers at the Catholic University Leuven in Leuven, Belgium.

- 1 'Broadening the application field of ceramic components by joint and interactive research on EDM machining technology, novel ceramic materials based on nanopowders made by SHS and design methodology'.

Funded by the FP6 specific programme 'Nanotechnologies and Nano-sciences' (NMP).
<http://cordis.europa.eu/marketplace/search> > offers > 8646

The manufacturing miracle

An EU project has produced a set of recommendations to make the manufacturing sector more sustainable, based on the latest EU directives. Environment, health and safety will all gain ground.



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Efficient industry and manufacturing processes play an important part in sustainable development. From reducing hazards and minimising waste to managing water and optimising resources, many processes related to production and storage can be improved significantly in favour of sustainability. The EU-funded

project Shape-Risk¹ aimed to advance this concept.

Working on streamlining integrated risk management, the project sought to produce useful guidelines for designing safer and cleaner industrial systems. It conferred with industry players in order to formulate

recommendations that meet different stakeholders' needs.

Moreover, the project developed its recommendations in line with expert authorities and bodies beyond industry to capture all the requirements needed to achieve its objectives. To illustrate, Shape-Risk considered risk management in

terms of environment according to the International Plant Protection Convention (IPPC), and looked at accident hazards according to the EU's Seveso II Directive.

Equally important, these recommendations took into consideration occupational health and safety as stipulated in the EU's ATEX Directive which describes the equipment and systems to use in potentially explosive atmospheres.

Under the project, a network of all these actors worked closely with industry, the public, government authorities and NGOs in order to build a set of highly valuable and useful recommendations. The expected outcome of project results is increased safety and minimised pollution all the way from raw materials to end products. With this, Europe's industries are destined to become cleaner, greener and much more sustainable.

The project was coordinated by the National institute for industrial environment and risks (INERIS) in Verneuil-en-Halatte, France.

- 1 'Sharing Experience on Risk Management (Health, Safety and Environment) to Design Future Industrial Systems'.

Funded by the FP6 specific programme 'Nanotechnologies and Nano-sciences' (NMP).
<http://cordis.europa.eu/marketplace/search> > offers > 8829

EVENTS

'EastLink: The Way to Knowledge Economy' Conference

The Klaipeda Science and Technology Park (KSTP) will organise its biannual EastLink conference on cooperation in science and business on 1 and 2 October 2012 in Klaipeda, Lithuania.

In line with the EU Eastern Partnership policy and EU Central Asia cooperation strategy, the EastLink conference will bring together science and business institutions from the EU, Russia, the Baltic States and Central Asia to discuss and identify key areas in science and business where closer cooperation can be fostered.

The main goal of EastLink is to reinforce existing links and create new partnerships in science, research and business cooperation in the post-Soviet geopolitical area with the aim of strengthening competitive positions in the global economy and promoting ties between institutions in the East and West.

For further information, please visit:

<http://www.east-link.eu/en/>

BioPartnering FutureEUROPE conference on life science partnerships

BioPartnering Europe will be held at the Square Brussels Meeting Centre in Brussels, Belgium from 7 to 9 October 2012.

Supported by the European Commission, EuropaBio, European Biopharmaceutical Enterprises and the European Biotechnology Network, the 20th Annual BioPartnering FutureEUROPE conference aims to promote innovation within the European life science industry, expand the global reach of biotechnology-based companies, and build sustainable profitable partnerships which are essential to the future success of the pharmaceutical and biotechnology industry.

For further information, please visit:

<http://www.techvision.com/bpfe/>

European MedTech Forum 2012

Jointly organised by the European medical technology industry associations Eucomed and EDMA, the European MedTech Forum will take place from 10 to 12 October 2012 in Brussels, Belgium.

Bringing together approximately 500 leaders active in the EU health-care scene, including policy-makers, scientific communities, patients' representatives, health-care professionals, academics and industry, the 2012 MedTech Forum will focus on topics under the banner 'Europe leading in value-based innovation — Smart regulation as a catalyst for growth'.

Attendees will discuss the status and outlook of collaborations between the different health-care actors in Europe and the implications of the European Commission's proposal for the Revision of the *In Vitro* Diagnostic and Medical Devices Directives in terms of patient access to safe medical technology, industry regulatory approval and venture capital investment in the future.

For further information, please visit:

<http://www.medtechforum.eu>

The 12th Annual Broadband World Forum 2012

Broadband World Forum 2012 will take place from 16 to 18 October 2012 at the RAI Exhibition & Convention Centre, Amsterdam, The Netherlands.

The 12th Annual Broadband World Forum conference and exhibition will bring together over 300 speakers along with 150 service-provider case studies to address the commercial and technical opportunities, developments and issues currently surrounding broadband. This year, there will be three co-located summits on-site dealing with the most pressing and topical issues in wireless technology, cloud computing and home networks.

For further information, please visit:

<http://www.broadbandworldforum.com/>

The eChallenges e-2012 Conference on Information and Communications Technology (ICT)

The 22nd eChallenges Conference, an international forum on Information and Communications Technology (ICT)-related research at European level (FP7), will take place from 17 to 19 October 2012 in Lisbon, Portugal.

The 22nd eChallenges Conference, supported by the European Commission, will provide delegates from leading commercial, government and research organisations from around the world with a forum in which to share knowledge and experience, lessons learnt, good practice and innovation in the field of ICT.

The goals of e-2012 are to promote ICT knowledge-sharing and innovation between commercial organisations, government agencies and the research community, exchange experiences about the current state of eAdoption at a sectoral, national or regional level, and stimulate the rapid take-up of research and technology development (RTD) results by industry, in particular SMEs.

For further information, please visit:
<http://www.echallenges.org/e2012/default.asp>

World Health Summit 2012: Research for Health and Sustainable Development conference

The M8 Alliance of leading academic health centres and medical universities is organising a high-level international conference, the World Health Summit, in Berlin, Germany from 21 to 24 October 2012.

The 2012 World Health Summit will bring together researchers, physicians, leading government officials and representatives from industry as well as from non-governmental organisations (NGOs) and health-care systems to debate the most pressing issues that medicine and health-care systems will face over the next decade and beyond, and to develop cogent and timely responses regarding the health of populations worldwide.

The conference will address how stable public-private partnerships and renewed political engagement with the understanding of health as a public good will be the basis for harnessing innovative power and scientific development in the future.

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

The 19th World Congress and Exhibition on Intelligent Transport Systems

From 22 to 26 October 2012, ERTICO - ITS EUROPE, in close cooperation with its counterpart regional organisations and the Vienna Exhibition & Congress Centre, will organise the 19th World Congress on Intelligent Transport Systems and Services (ITS) in Vienna, Austria.

Within the theme 'Smarter on the way', the 19th ITS World Congress will discuss innovative systems for the improvement of mobility and the use of intelligent systems and services within energy-efficient and environmentally friendly transport policies in Europe and across the world.

For further information, please visit:
<http://2012.itsworldcongress.com/content>

2012 European Scientific Conference on Applied Infectious Disease Epidemiology

The European Centre for Disease Prevention and Control (ECDC) and partners will present the 2012 European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) in Edinburgh, UK, from 24 to 26 October 2012.

The 2012 ESCAIDE conference will address ways to strengthen and expand the human network of all involved in applied infectious disease epidemiology and debate new models for sharing scientific knowledge and experience in this field, both in Europe and internationally.

The conference will also provide a dedicated platform for fellows from EPIET (European Programme for Intervention Epidemiology), FETP (field epidemiology training programme) and EUPHEM (European Public Health Microbiology Training Programme) to present their work.

For further information, please visit:
<http://ecdc.europa.eu/en/ESCAIDE/Pages/ESCAIDE.aspx>

'UrbanTec: Smart technologies for better cities' conference and exhibition

The Cologne Conference Centre in association with the Federation of German Industry will host the 'UrbanTec: Smart technologies for better cities' conference and exhibition on sustainable urbanisation from 24 to 26 October 2012 in Cologne, Germany.

The UrbanTec 2012 conference will bring together leading experts from politics, industry, business and science to discuss the main challenges facing urban infrastructure, such as sustainable concepts for traffic, efficient construction, intelligent energy and water supply, and the innovative solutions which can help overcome these challenges.

For further information, please visit:
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