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Special feature

Food for life: safety, services and the food chain

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More than food for thought

Genetically modified organisms (GMOs), functional food, organic food, food traceability and provenance... Food, it seems, is more than the basic nourishment our body needs to survive. Food and its production are a way of life for many millions in Europe. Food stories — both inspiring and alarming — fill magazines and the airwaves, as people become ever-more conscious of what they consume.

In this issue's special dossier we take a closer look at 'Food for life: safety, services and the food chain'. In our interview with Riitta Maijala, a scientist and director of risk assessment at the European Food Safety Authority, we discover the behind-the-scenes efforts to safeguard every step of Europe's food chain, from the 'farm to the fork' and back again.



The lead story in our biology and medicine section reveals the role of traditional foods as guardians of European culture. We follow this with a series of food-related stories ranging from how science is tackling pest infestations in Europe's olive groves, to the friendly bacteria behind tastier sausages.

We lead our energy and transport section with one of the big questions of today: 'Is Europe ready for hydrogen vehicles?' The answer is... go and read the story to find out!

Our piece on the decline of the honey bee and what this means to Europe's sensitive ecosystem gets our environment section off to a, well, buzzing start.

The IT and telecommunications technologies section is packed with eye-catching research results, headlined by three software development projects which are proving Europe's leadership in a field of growing importance to almost everything we do.

The industrial technologies section leads with a trio of stories on one of life's less pleasant by-products — waste. We feature new techniques for processing agro-industrial waste and discover how European scientists plan to make biogas from potato processing waste.

As usual, the events section offers you a selection of upcoming conferences, workshops and meetings in the field of research.

We look forward to receiving your feedback on this issue and on the *research*eu* publications in general. Questions or suggestions can be sent to: research-eu-supplements@publications.europa.eu

The editorial team

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Thank you to Riitta Maijala for her contribution to the 'special' dossier in this issue.

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Traditional foods can sustain European cultures

The British Nutrition Foundation (BNF) has published a report on traditional foods in Europe, along with a series of recipe cards.

The work is part of the EU-funded project 'European food information resource network' (Eurofir), whose objective is to develop a comprehensive food information resource. The data provided will offer an overview of the foods consumed across Europe.

Eurofir is funded under the 'Food quality and safety' thematic area of the Sixth Framework Programme (FP6) to the tune of EUR 12 million.

According to the researchers, traditional foods have been instrumental in how cultures and regions have prepared and consumed foods over many years. The preparation methods, in particular, are often linked to a country or region's folklore. People have also passed on their traditions from generation to generation, effectively turning these foods into a facet of cultural identity.

'Unfortunately, throughout Europe, some traditional foods are at risk of disappearing due to altered lifestyles,' explains Dr Helena Soares Costa of the National Institute of Health in Portugal, who is coordinating the traditional foods work package within Eurofir. 'Therefore, it is important to study and document traditional foods to sustain important elements of European cultures.'

A working group was established within Eurofir to gather information on traditional dishes from different European countries.

Traditional foods from 13 European countries (Austria, Belgium, Bulgaria, Denmark, Germany, Greece, Iceland, Italy, Lithuania, Poland, Portugal, Spain and Turkey) are featured in the report, which also includes information on the history of the countries featured.

The report examines whether traditional foods are considered healthier than modern foods. 'Traditional foods are great because they generally use local products, which is good for the environment,' says BNF's Dr Elisabeth Weichselbaum who co-authored the report. 'However, traditional foods are not automatically healthier than modern foods. The impact of traditional foods on our health depends on their nutritional composition.'

'A cuisine including high amounts of starchy foods, fruit and vegetables, and moderate amounts of fish and meat, such as the Mediterranean diet, will provide more health benefits than a dietary pattern high in meat and fat, and low in fruit and vegetables.'



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The recipe cards that accompany the report feature over 60 recipes from the 13 countries. The recipe cards are bilingual, with each recipe being set out in English and the language of the country the dish is from. Also included on the cards is information about protein, energy, fat (total and saturated), carbohydrates, sugar, sodium and dietary fibre.

'In order to eat a healthy, balanced diet, it is important to know what's in your food,' comments BNF nutrition scientist Bridget Benelam. 'When it comes to traditional foods, we are often unaware how much energy or fat they contain for example, so putting this information on recipe cards can help people get an idea how much the meal they are preparing will contribute to their daily energy and nutrient intake.'

Mrs Benelam concluded: 'The great thing about preparing your own meals at home, using for example these recipes, is that you can influence their nutrient and energy contents. You could cut down on some ingredients that are high in fat and replace them with [a] low fat version for example, or you could reduce the added salt. This can make your meal healthier, although strictly speaking it is not a traditional food any more if you change the recipe.'

Countries participating in the Eurofir project include Belgium, Greece, Italy, Lithuania, Norway, Slovakia, Switzerland and Turkey.

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Frequent acronyms

ERA European research area
FP5/6/7 Fifth/Sixth/Seventh Framework Programme of the European Community for research, technological development and demonstration activities

ICT information and communication technologies
IST information society technologies
R & D research and development
SMEs small and medium-sized enterprises



Reducing lignin biosynthesis in transgenic tomatoes

Plant scientists boosted levels of health-promoting phenolic compounds in genetically altered tomato plants by reducing lignin biosynthesis.

Flavonoids are a group of phenolic compounds found in plants and are increasingly thought to play a major role in promoting health and preventing disease. Their anti-oxidative properties include the scavenging of free radicals, which helps to delay ageing and prevent cancer and heart disease.

The project 'Improved antioxidant content for food applications' (Profood) was established as part of an EU initiative to improve the well-being of European citizens by developing plants with health-giving properties. The Profood consortium investigated methods for enhancing levels of phenolic compounds in transgenic tomato plants by limiting lignin biosynthesis.

The multidisciplinary team identified two tomato genes responsible for encoding cinnamoyl-CoA reductase (CCR), a key enzyme in the formation of lignin. Scientists subsequently used RNA interference (RNAi)

to target one of the genes and obtain transgenic plants with reduced lignin content. The level of soluble phenols was measured in the plants' vegetative organs and found to be higher in transformed compared to wild-type plants.

Phenolic compounds were analysed using high pressure liquid chromatography-mass spectrometry (HPLC-MS), which showed that plants with reduced lignin biosynthesis contained higher levels of chlorogenic acid and rutin. The HPLC-MS study also revealed new metabolites not found in wild-type tomato plants. Analysis of tomato fruits demonstrated moderate levels of two new compounds although the total phenolic content remained the same.



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Collaboration sought: further research or development support.
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Functional food from fungi

The market for antioxidants is increasing. Greater consumer awareness and an ageing population in Europe have contributed to the demand for food additives that defend the body against free radical damage. Among the growing list of safe anti-ageing food additives are carotenoids.

These organic pigments that give rise to the colour in egg yolk and the shell of a lobster are naturally produced in plants and some bacteria and fungi. European manufacturers use the fungus *Blakeslea* for the

biological production of carotenoids but the yield is far lower than that delivered by chemical manufacture.

The aim of the 'Fungal carotenoids' project was therefore to produce fungal strains with improved carotenoid content. Chemically induced mutation and fusing genetically different strains (heterokaryosis) gave rise to new genotypes. The most productive mutant had a five-fold increase of carotenoid content compared to the wild type.

The scientists used centrifuges to help extract the spores of the mutant cases with increased carotenoids.

Spores with low density were collected at the surface and wild-type denser bodies clumped at the bottom. Overall, the lighter spores had greater concentrations of pigment.

The theory that higher lipid content was responsible for the decreased density was also researched. Investigations revealed however that fatty acid content of the spores did not increase in line with pigment in the floating spore phenotype.

Further research is required to uncover the precise reason for changes in the density of spores with a greater concentration of carotenoid. Other techniques used to try to ascertain the chemical reasons for low density included thin layer chromatography and the use of radiolabelled isotopes.

Biological production of nutraceuticals has superior commercial and dietary value compared to those chemically manufactured. Manipulation of the genetics of micro-organisms to achieve higher yields would appear to be a promising avenue for further development.

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Eliminating toxicity in faba beans

After faba bean consumption, humans and animals experience a temporary decrease in levels of glutathione, which protects red blood cells from oxidant insult and haemolysis. Scientists observed laying hens fed on faba beans, in order to analyse the negative effects of toxic compounds found in the bean.

The EU continues to rely on imported, rather than home-produced plant protein, in the feed industry. This jeopardises the EU's goal of creating a more sustainable agricultural industry in Europe.

In the project 'Faba bean breeding for sustainable agriculture' (Eufaba), the partners set out to develop enhanced faba bean (*Vicia faba*) genotypes. Using a combination of genetic markers and conventional breeding methods, the scientists sought to breed a sustainable crop to be used for animal feed.

As part of the project, the toxic compounds contained in faba beans were analysed. Laying hens were fed higher concentrations (25 %) of faba bean in their diet. The researchers then studied the hens' red blood cells for changes.

Observations were carried out to examine how high or low the levels of vicine and convicine (V/C) were. Vicine is a glycoside found in the faba bean and it is toxic. This toxic compound was found to negatively modify body mass development and egg laying activity in the hens.

For the analysis, the researchers hypothesised that the levels of V/C in the diet would mirror the circulating levels of divicine and isouramil in the blood and therefore in the redox state of laying hen red blood cells *in vivo*. (Inactive V/C are activated in the presence of divicine and isouramil).

It was concluded that, the usage of cultivars low in V/C developed by the scientists, should be free of the negative physiological effects apparent in feeding with traditional faba bean cultures.



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Exercise: the way to a healthier European society?

It is known that regular exercise is beneficial for sufferers of type-2 diabetes, ischaemic heart disease, some types of cancer, dementia and possibly depression. One European project is investigating how regular exercise can be used in the prevention and treatment of various diseases.

Evald Bank is a retired Danish farmer in his sixties. Five years ago he was diagnosed with prostate cancer and is currently taking part in a two-year programme to help determine whether regular exercise can slow down the development of cancer. Evald follows an exercise regime at home and every six months he has a physical check-up where health data, such as body fat, is collected.

Researchers in the Exgenesis⁽¹⁾ project have carried out tests with hundreds of volunteers, both sick and healthy. The results show that the body activates various genes when muscles are contracted while exercising. The muscle also introduces substances into the bloodstream. These can have an effect on the liver, fat, the brain and possibly the cancer. The researchers are identifying and modelling such substances. According to the project coordinator, molecular biologist Grahame Hardie from the United Kingdom, they have identified a particular protein that plays a significant role in triggering positive effects during exercise.

In Copenhagen, the pathophysiological Allan Vaag is investigating how physical



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inactivity influences type-2 diabetes. The highest rate of the disease is found among people who remain inactive for most of the day (for example, truck or taxi drivers). Mr Vaag ran tests, having healthy volunteers remain nine days in bed, followed by several weeks of regular exercise. The physical inactivity leads to changes in glucose metabolism, fat metabolism, gene functions and other *in vivo* functions. These tests showed a direct correlation

between the length of physical inactivity and the body's susceptibility to type-2 diabetes and similar diseases.

Genetic studies done in southern Sweden, led by Finnish endocrinologist Leif Groop, found about 20 genes that are prone to type-2 diabetes. Furthermore, they could determine how regular exercise can influence some of these genes. Mr Groop now aims to identify ways of increasing the positive effects of exercise. In this manner, regular exercise could be made more effective in use against cancer or type-2 diabetes. According to Mr Groop, 10 % of all Europeans will have diabetes in the near future. It is, therefore, imperative that diabetes can be better prevented, since most countries will not be able to fund the treatment of so many patients.

Exercise is not the cure for sufferers of cancer and diabetes, but it could prove to be very important in the prevention and treatment of these diseases. European scientists hope to determine how this can be best achieved.

⁽¹⁾ 'Health benefits of exercise: identification of genes and signalling pathways involved in effects of exercise on insulin resistance, obesity and the metabolic syndrome.'

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Integrated pest management for olive groves

Olive growers from southern Europe to northern Africa will benefit from new knowledge acquired during the European Triphelio project that calls for more intelligent application of insecticides.

The Mediterranean is well known for its production of olives and olive oil. Unfortunately, olive trees are susceptible to several species of lepidopterous insects. The traditional approach has involved insecticide application to protect the crop. However, these chemicals pollute the environment in general and often also kill off the pest's natural enemies.

The project 'Sustainable control of lepidopterous pests in olive groves — integration of egg parasitoids and pheromones' (Triphelio), which

was sponsored by the INCO 2 programme, brought together research institutes from all sides of the Mediterranean to seek out new solutions to the lepidopteran threat. Scientists with the Plant Protection Research Institute (PPRI)

in Egypt evaluated the impact of common insecticides on the egg parasitoid *T. cacoeciae* Marchal.

Egg parasitoids are an effective method of biological control that targets the eggs of the lepidopteran, now playing the role of the host. The guidelines issued by the International Organisation for Biological Control were followed during the field tests. The PPRI researchers discovered that deltamethrin was the most toxic insecticide for *T. cacoeciae* while malathion was at the other end of the spectrum.

Mineral oils were also identified as a viable alternative thanks in part to their relatively short lifetime once released to the environment. Further to the experience gained during the project, the team at PPRI can advise the olive industry regarding pesticide application as part of a programme of integrated pest management.

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Choice of bacteria is the key to a perfect sausage

Fermented sausages, like salami, are an ideal way to preserve meat. Researchers have selected bacterial strains that will produce a delicious sausage with the correct texture as well as being free from food spoiling microbes.

The secret of the perfect fermented sausage is not just a matter of taste and consistency. Researchers in the appropriately named EU project 'Safety of traditional fermented sausages: research on protective cultures and bacteriocins' (Safesausage), also focused on the important matter of keeping one of Europe's favourite meat products free of food poisoning agents such as strains of *Listeria*.

The biotechnical way of achieving a safe tasty sausage is to use the principle of competition between warring microbes. Bacteria produce toxins made of protein, bacteriocins. Their role is to kill off competing microbes that may be taking food and space from the bacterium's territory. Harnessing this principle, project researchers at ETAT SA in Athens isolated promising strains of *Lactobacillus sakei* (*L. sakei*) to ward off the bacterium that causes listeriosis, *Listeria monocytogenes*. Equally

as important, *L. sakei* strains produce an appetising sausage during the fermentation and ripening processes.

Further trials showed that the bacterium *Leuconostoc mesenteroides* was an even better bioprotective agent than *L. sakei*. Given the success in isolating these strains, the researchers also devised a new method to specifically produce the selected bacteriocins from the two species. Based on ammonium precipitation, semi-purified samples of the bacterial toxins can be produced efficiently.

Further scope for improvement may come

from the isolation of other bacteria that would enhance the defensive nature of the bioprotectors. The range of fermented sausages within Europe alone is vast, given that there may be hundreds of different types of bacteria in one brand of sausage. The project partners therefore aim to extend their research efforts and collaborate with other interested parties in the production of fermented foods.

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INTERVIEW

More food for thought: *research*eu* results supplement talks with Riitta Maijala of EFSA

Dr Riitta Maijala has been the director of risk assessment at the European Food Safety Authority (EFSA) since 2008. Her directorate supports EFSA's core business of delivering risk assessments and scientific opinions to risk managers by providing the secretariat for each of EFSA's scientific panels.

Before joining EFSA, her career was based in public administration in Finland, where her most recent role was as the head of the animal health and welfare unit at the Finnish Food Safety Authority (EVIRA). She was a professor and head of the risk assessment department at the National Veterinary and Food Research Institute from 2001 to 2005 and development director (risk analysis) from 1998-2001. She was also a lecturer on environmental health control at the University of Helsinki. She has held a number of international roles including being a member of the European Commission's scientific committee on 'Veterinary measures related to public health, vice-chair of EFSA's 'Biohaz panel' and president of the European College of Veterinary Public Health.

Riitta Maijala holds a doctorate of veterinary medicine and a PhD from the College of Veterinary Medicine in Helsinki, as well as a postgraduate degree on food hygiene and a specialist degree in veterinary medicine on infectious animal diseases. She also holds a diploma from the European College of Veterinary Public Health (Dipl. ECVPH) and an adjunct professorship on food hygiene for the University of Helsinki's department of food and environmental hygiene.

• How did EFSA come about?

EFSA was set up in January 2002 following a series of food crises in the late 1990s, as an independent source of scientific advice and communication on risks associated with the food chain. EFSA was created as part of a comprehensive programme to improve food safety in the EU, aiming to ensure a high level of consumer protection and to restore and maintain confidence in the EU food supply.

EFSA produces scientific opinions and advice to provide a sound foundation for European policies and legislation and to support the European Commission, European Parliament and EU Member States in taking effective and timely risk management decisions.

EFSA's remit covers the evaluation of food and feed safety, nutrition, animal health and welfare, plant protection and plant health. In all these fields, EFSA is strongly committed to providing objective and independent science-based advice and clear communication grounded in the most up-to-date scientific information and knowledge.

• EFSA has a tough job. Regulations change, businesses expand, the technology advances and the science improves. How does it cope with such an ever-changing environment?

The science underpinning European food and feed legislation has been greatly reinforced by the increasing level of resources devoted to scientific risk assessment by EFSA.

EFSA communicates actively with all those involved in the food chain. Through co-operation with Member States and regular contact with stakeholders, EFSA strives to address major changes in this constantly-changing environment. This dialogue shapes EFSA's working plans.

To mention a few figures: EFSA has a staff of over 400, approximately 60 % of whom are engaged in scientific activities. We form a solid network with the national food safety agencies and more than 370 scientific organisations work together with us as part of that network.

Over 1 500 experts from countries inside and outside the EU contribute to our core mandate of providing scientific advice every year. EFSA published 500 scientific outputs in 2008 and nearly 650 in 2009.

• Food and feed comes from all over the world now: Is EFSA's work made more difficult or easier with globalisation?

The increasing globalisation of the food supply presents challenges for Europe. A single food product may contain ingredients from across the globe, many of which are produced to standards that vary significantly from those used in Europe. Globalisation further underlines both the need to have a European risk assessment body and to take into account data and risk assessments available in other parts of the world.

Since food safety has no boundaries, EFSA has fostered cooperation with EU risk managers, Member States and international



Dr Riitta Maijala

organisations such as the World Health Organisation (WHO) and Food and Agriculture Organisation (FAO), and third countries, including the USA, Japan and China, to exchange data approaches, necessary to evaluate the risks.

This cooperation with all stakeholders and partners in the food chain is an integral part of the way we work. Similarly, we aim not only to react swiftly to urgent situations — as we have done on several occasions recently (for example following the contamination of Irish pork with dioxins and of milk products from China with melamine) — but also to predict and analyse possible threats before they impact upon public health, animal or plant health or the environment.

• Food can be a contentious issue: how important is science and research to allaying public fears about, for example, the European Commission's new ruling on cultivating GMO potatoes?

EFSA is aware that food can be a contentious issue, and that on genetically modified (GM) technology for instance, there is a broader debate on which many points of view are expressed and that do not only cover science but also broader societal, political and economic concerns.

Based on legislation, EFSA's role in the EU food safety system is solely related to providing scientific risk assessment and EFSA aims at doing so according to the highest standards and ensuring that the latest scientific knowledge and approaches are taken into account in its opinions.

The other main role of EFSA is risk communication. In order to communicate assessment results clearly and appropriately, EFSA works with organisations that have close contact with consumers in the Member States, such as national food safety bodies, and other stakeholders.

EFSA's role is to provide an independent assessment of the safety of each GMO based on the most rigorous risk assessment standards and methodology — all according to European Union and internationally agreed standards.



In the case of the GM potato Amflora, following a request from the European Commission we were asked to produce a joint scientific opinion on the use of antibiotic resistance marker genes in GM plants. The final decision for authorising the potato for cultivation was taken by the European Commission, taking into account EFSA's advice and other factors.

• **How does one measure risk and at what point does a health risk outweigh a health benefit?**

EFSA generally determines how much of a substance can be consumed — either in a single sitting, or every day over the course of a lifetime — without causing any adverse health effects and compares this with data on known consumption levels for different groups of the population. This allows conclusions to be reached on whether or not there are any safety concerns.

Balancing potential risks with health benefits is more complex. Until now this has not been done systematically, at least at the European level, although EFSA's 'Contaminants in the food chain' (Contam) panel has adopted two opinions which include risk-benefit aspects — for example, when looking at the risk of being exposed to nitrates when eating vegetables, the Contam panel concluded that 'the estimated exposures to nitrate from vegetables are unlikely to result in appreciable health risks, therefore the recognised beneficial effects of consumption of vegetables prevail'.

EFSA's scientific committee has recently suggested a new approach to the risk-benefit assessment of foods, based on clearly-defined parameters which are agreed between decision-makers and those carrying out the scientific risk-benefit assessment. If risks do not clearly outweigh benefits (or vice-versa), this could ultimately involve the calculation of a single 'net health impact' value.

• **Can you describe some of the more recent technological advances that help improve safe-monitoring of food?**

Monitoring of food is the responsibility of policy-makers at both the European and national levels. This is supported by one of the most effective tools to monitor risks, called the 'Rapid alert system for food and feed' (RASFF).

RASFF was put in place to provide control authorities with an effective tool to exchange information about measures taken responding to serious risks detected in relation to food or feed. This exchange of information helps Member States to act rapidly and in a coordinated manner in response to a health threat caused.

Its effectiveness is ensured by keeping its structure simple. This means establishing clearly identified contact points in the Commission, EFSA, the European Environment Agency (EEA) and on the national level in member countries. The contact points are able to exchange information in a clear and structured way.

EFSA is aware that strong cooperation in this field is needed in order to respond quickly to new or emerging challenges. To this end, in January 2010 EFSA established a system for the routine monitoring of data from RASFF, to describe potentially relevant patterns of notifications in order to help identify emerging risks.

• **EFSA's data collection helps identify early emerging or re-emerging risks to the food supply chain. How are you able to collect, collate and analyse data and make it coherent for national and international agencies as well as the European consumer?**

Access to reliable and comparable information and data on food consumption is critical in providing answers both to possible food safety and nutritional concerns.

When a new hazard is found in the food chain — for instance the recent cases of melamine found in various foods or dioxin contamination of pork — scientists must quickly assess who is exposed, through which foods and at what levels. Scientists in Member States and at EFSA rely on food consumption data collected at national level. Progress has been made in recent years, spearheaded by EFSA and its 'Advisory forum', to bring together such data in order to allow more efficient and accurate exposure assessment at EU level. Nevertheless, important differences in food consumption data collection remain and hamper the effective use of such data for risk assessment at EU level.

Members of EFSA's 'Advisory forum', bringing together national food safety agencies from the 27 Member States, are working towards the establishment of a pan-European food consumption survey (called the 'EU menu').



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This critical tool and building block for risk assessment will allow the collection of detailed and harmonised food consumption data at the level of individuals across the EU.

• **Lab results give definitive responses. But does EFSA also consider ethical, social, economic and environmental issues when it measures risk? And if so, how?**

EFSA's remit is to focus on science. So while EFSA is aware of other aspects such as ethical, social and economic issues, it cannot take them into consideration. This is for policy-makers in the Commission and EU Member States to consider.

Regarding environmental issues, EFSA does pay specific attention to environmental risk assessment and does so in various contexts of its risk assessment work. It is the case for instance of its evaluations on plant health, pesticides, GMOs and feed additives.

On pesticides, EFSA evaluates whether, when used correctly, these products can be considered safe for the environment. Pesticides should not have direct or indirect harmful effect not only on human or animal health, but also on the environment. In assessing their environmental safety, EFSA takes into consideration various aspects, from impact on groundwater to effects on various organisms which may be affected by the substances in pesticides, even when these are used correctly.

On plant health issues, EFSA also evaluates protective measures against the introduction into the EU of organisms harmful to plants, some of which may be a serious threat with far-reaching economic, social and environmental consequences.

In the case of GMOs, before they may be introduced in the European Union they have to undergo an extensive environmental risk assessment (ERA) in order to identify any possible adverse effects they may have on the environment. Each application includes data covering several seasons of field growing trials and it has to be accompanied by an environmental monitoring plan, which allows the identification of any potential long-term effect to ecosystems.

EFSA recently launched a public consultation on its guidelines for the environmental risk assessment of GM plants. In the document, EFSA reviewed and updated the specific areas that need to be addressed when assessing

the environmental impact of a GM plant. The document contains new, strengthened requirements in terms of data generation, collection and analysis. Also, since some GM plants can produce an insecticide which wards off attacks from certain insects, EFSA has included a revised section on how to ensure that plants do not adversely affect other insects (the so-called non-target organisms).

EFSA also evaluates environmental aspects in the context of other issues, such as animal health and welfare issues. When considering feed additives, EFSA not only ensures that they are safe for animal and human health, but it also verifies that they do not have adverse effects on the environment.

• ***The Lisbon strategy identifies science and innovation as key drivers to the EU economic competitiveness. Can you comment on an EU funded project in the food or feed sector? How has it benefited the EU?***

It is critical that Europe continues to invest in research so that industry can innovate and remain competitive. One of the issues that has to be kept in mind is the balance between innovation and consumer protection.

For us to carry on protecting public health and the environment, EFSA recognises the need for further research. That work is precious and it is vitally important that Europe not only maintains but goes on to bolster its risk assessment capacity.

In this respect, EFSA holds important dialogue with the Commission's Directorate-General for Research (Research DG) to ensure that member state risk assessment requirements are fully considered in Europe's research spending.

We will benefit from even better scientific results that can be used during our risk assessment, thanks to the European research area and the EU Seventh Framework Programme for research (FP7), especially the Cooperation programme which looks at how best to overcome the traditional fragmentation of research efforts in the EU through better coordination and cooperation.

In past years, we have liaised closely with some research projects under FP6 and FP7 as EFSA was part of the advisory group. EFSA was involved in the Euphresco programme supporting for plant health policy and also in the project 'Heat-generated food toxicants, identification, characterisation and risk minimisation' (Heatox) which looked at acrylamide and its impact on health.

Although EFSA does not have the same budget as Research DG in terms of funding, our Founding Regulation allows us to fund competent scientific organisations in Member States to bring their expertise to the EU level through so-called

Article 36 grants. Activities carried out by these partner organisations on EFSA's behalf include data collection, preparatory work for the development of scientific opinions, and other scientific and technical support.

A recent example is the report on 'Colony collapse disorder' on honey bee mortality and the ways that colony losses are monitored in Europe. The study was funded by EFSA and carried out by a consortium of scientific institutes led by the French national food safety agency (AFSSA).

The report makes recommendations on how to improve bee surveillance systems and says further studies are needed to better understand the factors that affect honey bee health. The report has now been published and presented to the European Commission. It will help to inform future research and surveillance activities to address the issue of colony losses.

• ***You have had this job now since 2008. What have been some of the key challenges you have faced?***

I think what comes to mind first is the workload. In 2009, EFSA adopted nearly 650 scientific outputs and the demand for EFSA's scientific opinions on food and feed safety issues is expected to remain high for the coming years with at least 60 % of outputs related to applications. EFSA has received significantly more questions than originally planned when it was established.

Handling this amount of work has required analysis of working methods and innovative approaches on how the work of the scientific panels can be further supported. EFSA had to set up 10 panels, recruit scientific experts and define working methods with them. Additionally, we had to make sure that we maintain the scientific excellence and the quality of our opinions.

To be able to carry out more tasks, we also increased our cooperation with Member

States through the creation of working groups and further developed the European network of scientific risk assessment. Part of this has been achieved through the increase of preparatory work and data collection, for example, outsourcing amounted to

EUR 2.9 million in 2007 and reached EUR 6.8 million in 2009.

The second challenge is guaranteeing how to continue to provide independent scientific advice which for us is self-evident but may not be immediately obvious to the outside world.

All our experts are appointed based on their scientific excellence and

expertise and none represent any institution or member state. Yet, we have put in place procedures to ensure they act independently and have developed one of the most robust 'Declaration of interests' policies in the world.

Last but not least, globalisation has forced us to rethink our risk assessment methods and how to harmonise them. EFSA provides a unique opportunity for this since we look at risk assessment throughout the food chain — from farm to fork including plants, animals and humans up to nutrition. However, this is something which EFSA cannot and does not want to do in isolation. Many risk assessment guidelines and principles are decided by international bodies such as Codex, the World Organisation for Animal Health (OIE) and the Organisation for Economic Cooperation and Development (OECD), and therefore our contribution to enhance horizontal discussion for methods used for risk assessment is crucial.

These challenges are important, but with talented, motivated staff and excellent scientific experts, I am confident they can be met. Working in EFSA has been a big honour for me — and great fun.

Thanks to Riitta Maijala and the EFSA (www.efsa.europa.eu) communications team for their contribution to our special.

Euphresco was funded by the FP6 programme ERA-NET and Heatox was funded by the FP6 thematic area 'Food quality and safety'.



Zinc supplements for older people

Zinc is vital for proper nutrition and is particularly crucial for those in late middle age or older. The Zenith project explored the effect of zinc supplements on ageing citizens as part of a Europe-wide health initiative.

Zinc plays an important role in the human diet and is essential for our health and well-being, possessing anti-oxidative properties that help protect against degenerative diseases common in old age. Studies suggest that the elderly may suffer from zinc deficiency and can benefit from food supplements containing the element. However, excessive quantities of zinc can interact with the body's metabolism of copper and iron.

Researchers from the EU-funded 'Zinc effects on nutrient/nutrient interactions and trends in health and ageing' (Zenith) consortium investigated the beneficial, or possibly adverse, effect of zinc supplements on men and women who were in late middle age or older. Scientists conducted in vitro studies into the long-term effects of zinc on copper-induced oxidation of low-density lipoprotein (LDL). Research has indicated that oxidation of LDL is one of the earliest biochemical events in the path to atherosclerosis and heart disease.

For six months healthy male and female volunteers in late middle age received

either a moderate dose of zinc supplement or a placebo. As part of the investigation, dietary intake of zinc, copper, iron and vitamin E was monitored at the beginning and end of the study for each subject and found to be acceptable.

Results showed that the supplement increased levels of zinc in blood serum but did not significantly alter levels of copper, iron and vitamin E. Furthermore, the long-term zinc supplement had no impact on in vitro LDL oxidation. It appears therefore, that moderately enhanced levels of zinc do not influence copper-induced LDL oxidation in the age range under study.

Findings from the Zenith project were used as the basis for specific public health recommendations regarding dietary zinc intake for people aged 55 years and above. In this way the work can contribute to improving the health and quality of life of Europe's ageing population.

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).

Collaboration sought: Further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5357



When the sound reflects the action

An awareness of facial expression is crucial for infant development as well as an important means of non-verbal communication generally. European researchers have investigated whether sound modulates the response to visual actions.

Facial expressions and body movements are highly important means of non-verbal communication. Many animals display facial signs but these are more well-developed and complex in primates and humans. The area of the brain involved in processing these signals is the superior temporal sulcus (STS).

Also responsible for the integration of multisensory input, the STS is an integral part of the mirror neuron system, the target of study of the European project of the same name. 'The organisation and cognitive role of the mirror system' (Mirror) project partners studied the precise role of this system in functions such as imitation and understanding the intentions of others.

Researchers at the University of St Andrews in Scotland specifically investigated whether the neurons processing visual input also integrated the sound associated with these actions. The overall aim was to test if facial expression accompanied by sound influenced, positively or negatively, the observer's reaction.

In almost a quarter of mirror neurons responsive to the sight of actions, sound modulated their response. The sound of an action could either increase or decrease the neuron reaction. Interestingly, when the level of response was greater, the extent of the increase depended on whether the sound matched the action.

Applications for this data include an increased understanding of the neurological status of autistic patients. A deficit in development of the mirror system has been implicated as a possible reason for some of the symptoms associated with autism. Furthermore, knowledge of the operation of the mirror neuron system, essentially a motor system, could be used in rehabilitation of stroke patients.

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).

Collaboration sought: Further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5364





Sensors for the harshest of environments

Researchers from the EU-funded Matinoes project investigated the development of rapid, affordable sensors for biotechnological production processes. The focus was placed in particular on optical sensors for monitoring harsh reaction environments.

Optical fibres are used to transmit electromagnetic radiation from the sensing region that is in direct contact with the sample under analysis. All important are the immobilised reagents in the coating material that help to measure the chemical changes under scrutiny.

The project 'Novel organic-inorganic materials in opto-electronic systems for the monitoring and control of bio-processes' (Matinoes) developed sensitive coatings for enzyme-based intrinsic and extrinsic optical sensors. The chemical foundation for the new coating material was a hybrid organic-inorganic polymer. Its different components gave a variety of options during the final design of the sensors.

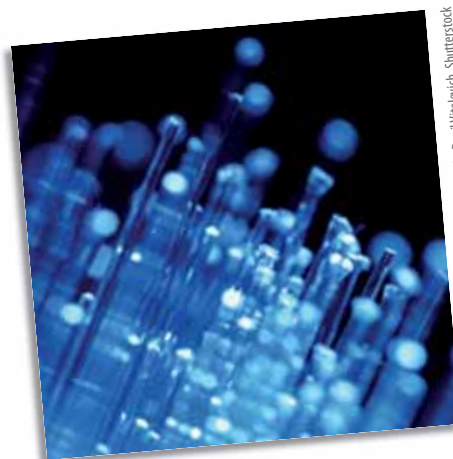
The incorporation of enzymes for catalysis of the oxidative reactions demanded certain biochemical design features. First, rapid film curing can be achieved with ultraviolet light as opposed to heat to prevent the denaturation of the enzymes. Furthermore, hydrophilic groups were in-

corporated into the polymer as enzyme solutions are water-based.

Second, the sensor's detection of reactants is based on the consumption of oxygen. Ruthenium complexes to measure this process were therefore integrated into the coating. The hydrophobic groups included facilitate the migration of oxygen, increasing sensitivity to the gas.

The range of coating materials that can be derived from the starter compounds gave two options for the final assembly of the sensor — built up as either a single- or a double-layer structure. In the double layer, the primary coating contains the ruthenium complex and the secondary layer houses the enzyme. The single coating contains both the oxygen sensor and the enzyme.

Optical sensors developed can be used to achieve continuous real-time monitoring in many kinds of analytical sciences. Detection of pollution, biotechnological



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processes, water analysis, clinical chemistry and invasive medical techniques are all areas that stand to benefit from advances in this technology.

Funded under the FP5 programme Growth (Competitive and sustainable growth).

Collaboration sought: Further research or development support; joint venture agreement; licence agreement; manufacturing agreement; private-public partnership.

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See also page 25 'High-tech tools help sniff out volcanic gas'

Safer vaccine for a dangerous bacterium

The search for safer vaccines against virulent human pathogens like Streptococcus pneumoniae continues. European researchers have developed anti-pneumococcal antigens using genes from a bacterium normally used to produce cheese and buttermilk.

Streptococcus pneumoniae is the main cause of bacterial meningitis, peritonitis and, as its name suggests, pneumonia. Researchers with the European project 'Nutra cells' ⁽¹⁾ aimed to develop the basis of an anti-pneumococcal vaccine using a bacterium that is normally non-infectious to humans.

The scientists chose the bacterium *Lactococcus lactis*, extensively used in the dairy industry. Considered to be a safe vehicle, the milk produce bacterium was engineered to incorporate genes from *S. pneumoniae*.

The aim was to induce the new strain to produce polysaccharides present in the structure around the wall of *S. pneumoniae*, the capsule. A common feature of both microbes, the capsule's polysaccharide components can be used to induce an immune response.

The gene from *S. pneumoniae* coding for the capsule polysaccharide (CPS) type 14, was inserted into *L. lactis* together with others from the gene cluster necessary for its production. The new *L. lactis* strain successfully produced the capsule polymer, normally a chemical signature of *S. pneumoniae*.



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Not only was the polymer biochemically identical to that of the virulent bacterium but the site of production held a special advantage. The new polysaccharide was released into the medium — exopolysaccharide (EPS) biosynthesis — making it a lot easier to isolate from the cells that manufactured it.

Safety of vaccines is an emotive issue. Fear of unwanted side-effects, including contracting the disease itself, can undermine social health schemes. Development of safe vaccines can help to allay public opposition and make health programmes more effective.

⁽¹⁾ 'Increase in nutritional value of food raw materials by addition, activity, or in situ production of microbial nutraceuticals.'

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).

Collaboration sought: further research or development support.

<http://cordis.europa.eu/marketplace> > search > offers > 5349

Livestock parasites halved with a single-dose vaccine

A European-funded project has completed major research into the formulation of a new one-dose vaccine for the control of indigenous parasitic diseases in Latin American countries.

The bid to feed large populations in developing countries is burdened by the threat of livestock disease. The 'Recombinant BCG' project, funded by the EU, aimed to develop a multivaccine to address this agricultural problem. Diseases targeted were bovine tuberculosis together with parasites causing schistosomiasis and fascioliasis.

Over a period of five years, the consortium of six universities from northern Europe and South America pitched their expertise at the microbial, genomic and immunological aspects of the project objectives. One of the teams of scientists based in Brazil focused its attention on the development of a vaccine to control schistosomiasis (caused by *Schistosoma mansoni*).

Reliant on the presence of water and its intermediate host, a water snail, *S. mansoni* is a significant parasite both in cattle and humans. Not only that, but due to their large size and longevity, cows can act as very large reservoirs for the adult worms and increase maintenance and dissemination of the disease.

The antigen *S. mansoni*14 (Sm14) had previously shown considerable promise as a component of vaccines. One special feature of Sm14 is its immunological activity against both *S. mansoni* and *Fasciola hepatica*, another predominant ruminant parasite that causes fascioliasis.

The Sm14 antigen was cloned, fused with another protein and then lodged in the cell wall of the tuberculosis-causing bacterium, *Mycobacterium bovis* BCG. This resultant rBCG-Sm14 strain did not induce anti-Sm 14 antibodies in test mice. However, the rodents did produce more gamma interferon from white cells from the spleen, an indication of T-helper type 1 response.

Further evidence of the effectiveness of rBCG-Sm14 emerged in mice infected with the water-borne stage of the schistosomiasis parasite.

Clearly, a one-dose regime for the control of parasitic diseases in livestock is preferable from a practical point of view to a multiple-dose programme. The single dose format offers increased vaccination opportunities with potentially improved vaccine safety.

Funded under the FPS programme INCO 2
(Confirming the international role of Community research).

Collaboration sought: information exchange/training.
<http://cordis.europa.eu/marketplace> > search > offers > 5350

Mice immunised with only one, or at most two, doses showed a reduction of almost half the resulting worms — only achievable previously with three doses of the pure antigen.



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Advancing on hydrogen

Is Europe ready for hydrogen vehicles? A deployment of hydrogen powered wheelchairs, trucks and buses by a European project is set to find out whether the technology is ripe enough and whether this new generation of vehicles will be readily accepted.

The 89-year-old retired farmer, Francisco Muñoz Tierno, has moved to Soria, to the north-east of Madrid. He is one of the first to try a new pioneering vehicle. It is a prototype wheelchair powered with a hydrogen fuel cell. Such prototypes have been built as part of the European project 'Hychain-Minitrans'. The project will trial vehicles with pressurised hydrogen as an alternative fuel in real-life situations. The devices are, to a large extent, based on existing electric vehicles. The wheelchair is powered using two main components: a hydrogen energy system based on a fuel cell and a battery array.

The hydrogen fuel cell is a device that produces an electric current by allowing hydrogen to react with oxygen in the air. The system is straightforward and required no complicated conversion processes.

Using the hydrogen energy system for the wheelchair has three primary advantages: a longer travelling range than conventional electrical wheelchairs; it only takes a few minutes to replace an empty hydrogen canister rather than up to eight hours to recharge an electrical wheelchair; and the lightweight hydrogen makes transportation easier.

Soria is a city already investing in wind and solar energy. It is one of the four regions in Europe being used by the Hychain project as a base for the development of hydrogen transportation networks. Another of these regions is Nordrhein Westfalen in Germany. What was once a former coal mine near the town of Herten is now a hydrogen technology centre. It is here that cargobikes, another form of hydrogen-powered transportation, are being developed. These are lightweight bicycles used for transporting cargo and are being tested by a local telecommunication company.



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Hydrogen power can also be used for larger vehicles. The bus line No. 266 in the nearby town Bottrop is run using a hydrogen-fuelled bus that produces no greenhouse gases and is much quieter without the noise of the combustion engine. However, according to the bus driver, it is not the smoothest of rides and it can be noisy for those inside the bus. Instead of relying on exchangeable canisters of hydrogen, the bus has a gas tank that can be refuelled at particular service stations within the town. But before hydrogen can be used as an alternative, the necessary infrastructure for distribution must be created, including the installation of hydrogen pumps at service stations.

These prototypes are only designed to be driven inside cities. Since they have a range of 100 to 120 kilometres they would be of very limited use for travelling between cities. Besides, with a maximum speed of 50 kilometres per hour, the vehicles are not fast enough to be operated on highways.

Unfortunately, the production of the hydrogen itself is not yet so environmentally friendly and normally involves the use of hydrocarbons. It is hoped that a greener production method will be possible in the near future. One possibility may be the solar-powered electrolysis of water. But, excluding its production, the employment of hydrogen means no greenhouse gases or pollution, in fact the only by-product of the hydrogen reaction is pure water.

Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> >
 search > 14214

Teaching your car how to drive

What if your car could learn how you handle different driving situations, then alert you if you fail to slow for a curve or start driving erratically? A European research project has already built a working prototype of a car so smart that it goes to driving school every day.

Drivers go to school to learn to anticipate emerging situations and respond appropriately. Why shouldn't cars do the same?

That is the question Florentin Wörgötter and his colleagues at the EU-funded research project 'Learning to emulate perception action cycles in a driving school scenario' (Drivisco) asked themselves three years ago.

Their answer was that, with state-of-the-art sensors, image processors, and learning algorithms, a car that smart could be built.

The result, now tested in a prototype vehicle, is a system that tracks a driver's every move, matches those actions with what it 'sees' down the road, and learns how that driver normally handles situations such as upcoming curves or other vehicles ahead.

With its infrared headlights, stereo cameras, and advanced visual processing the system can actually see better at night than a human driver. It has proved its worth by providing early warnings of hazards a human driver had not yet seen or reacted to.

'What we wanted was a system that learns to drive during the day by correlating what it sees with the actions a driver takes,' says Mr Wörgötter. 'Then at night the system could say, "Slow down, a curve is coming up!" — a curve the human didn't see. Now we have a prototype that does this.'

When artificial intelligence researchers first set out to give machines vision they





© Drivisco

had no idea what an enormous problem they were taking on. A scene that makes perfect sense to us — a clearly defined roadway curving into the distance, trees and signs slipping by, other vehicles scattered in the lanes ahead, some moving at our speed, others pulling away or looming closer — starts as nothing more than a sea of coloured pixels to a computer.

The Drivisco researchers drew their inspiration from what has been learned in recent years about how the brains of humans and other animals do such a remarkable job of making sense of the patterns of light dancing over their retinas. A key feature turns out to be constant two-way feedback between higher- and lower-level visual areas.

As we drive, high-level visual areas that store complex perceptions such as 'car getting closer' or 'person crossing the road' are constantly active. These areas send messages — feedback — that interact with incoming signals representing more basic features such as edges, colours, and movement. When there's a match, an object pops out of the background, complete with perceptions of its size, location, and movement.

'How the visual front-end of Drivisco works was very much inspired by the visual cortex of vertebrates,' says Mr Wörgötter. 'The feedback mechanism, where higher-level modules interact with modules that detect simpler features, solves the very difficult problem of detecting independent objects even when you and they are moving at the same speed.'

Having provided their prototype car with an advanced vision system, the Drivisco team next set out to make it smart enough to learn how to drive.

'The idea was that cars should be able to learn from the driver to be capable of driving autonomously,' says Mr Wörgötter. Since cars are not legally allowed to drive themselves, he adds, the system limits itself to providing a warning when the driver is not responding to an upcoming situation as expected.

In the future, however, the system might also provide more insistent feedback. For example, Mr Wörgötter says, if you were heading off the road it would make steering much stiffer in that direction and much lighter in the direction that would get you back on track.

The system learns by building up a huge database of associations between the driving situations it sees

— for example heading into curves at various speeds — and the actions the driver takes in terms of steering and speed changes.

The system looks at the scene, analyses it, and matches it with the actions the driver is taking. This cycle repeats 20 times per second. 'So you get a whole stream of vision-action links,' Mr Wörgötter says.

Like a person learning to drive, the system gets better over time. After processing terabytes of information,

the Drivisco system was able to produce consistent real-time predictions of how a particular driver would handle most highway or country road situations. City driving situations are still too complex for it to master.

Mr Wörgötter was particularly pleased when the system proved able to generalise what it had learned to new roads and novel situations.

The system also showed that it could learn individual driving styles. 'An old granny may not want to drive as fast as Michael Schumacher,' Mr Wörgötter says. 'This is quite important in the car industry.'

Wörgötter expects that after the current financial crisis eases, major car manufacturers will want to incorporate DRIVISCO's vision and learning advances into their high-end vehicles.

'The ability to learn from a driver is quite new,' he says. 'I think it has great potential as a commercial product.'

The Drivisco project received funding from the FET open strand of the EU's Sixth Framework Programme for research.

Promoted through the ICT Results service.
<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91147>



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Software's take on the light bulb joke

It takes five men to change a light bulb⁽¹⁾, even more to pack a shipping crate. After all, filling space is very hard. But a European project has developed tools to optimise packing problems in just a few seconds — no joking...

Packing problems tend to be extremely complex. Even the apparently simple task of filling an empty crate with boxes of light bulbs is harder than it looks. Lie them all down or stand them all up? Add in different sizes or odd shapes and you get a major headache. And just when you thought you were doing well, you realise that certain bulbs must be at the top of the crate and the crate has a maximum weight!

Computers are the powerhouses for solving this kind of optimisation problem. They use advanced mathematics to churn through the numbers, check every solution against all the constraints and eventually — probably in less than a minute, actually — find the best fit.

An EU-funded project has done just this to develop tools that will be welcomed by thousands of companies across Europe who struggle to pack efficiently on a daily basis. In just a few seconds the tools can improve on what specialist packing teams might have taken a week to design.

Net-WMS⁽²⁾ has taken a healthy mix of pure mathematics, added in some real-world complexity, and managed to create functional tools with immediate commercial applications.

The Net-WMS consortium pooled the expertise of some of Europe's best research departments in the field of optimisation.

'We decided to focus our attention in the area of spatial optimisation because there was an obvious commercial opportunity,' explains François Fages, the project's scientific coordinator. 'Many firms cannot afford expensive software, but even small improvements in the way they pack shipping pallets or use warehouse space, for example, can make an enormous difference to their profitability and competitiveness.'

The basic research has produced algorithms that really push the boundaries in this field. The algorithms use what is called a 'constraint programming approach'. Simply, this is a two-step approach. First, you apply all the various constraints (in various combinations) as a way to shrink the 'search space' — i.e. all the possible solutions to the problem that you need to look at more closely — to try and find the optimal answer. This 'pruning' of the search space remains active in the next stage — the actual search for the optimal solution — and makes it much faster and more efficient.

Researchers also developed a novel way to eliminate 'forbidden regions' — approaches to the problem that will inevitably lead to a dead-end or an impossible solution.

'The algorithms developed in the project are quite unique,' claims Mr Fages. 'We've really broken ground with this project. Our scientific results have been published in eight peer-reviewed scientific journals and presented at several international conferences.'

The project also developed an entire language to express the constraints of a problem, including business constraints such as maximum weights or stability constraints for a pallet.

The different modules of the Net-WMS system — the spatial algorithms, rule program and a virtual reality module for better visualisation — are all interconnected so that it is possible to create a seamless software solution to model, simulate and optimise the packing process.

One of the Net-WMS commercial partners, KLS Optim, has been working with the Net-WMS tools and building them into a commercial product. The French company is a start-up, established to exploit the output from the project.

KLS has tested its software with a number of clients and produced some remarkable results. Abder Aggoun, technical manager of Net-WMS and CEO of KLS Optim, reports that his company's software can improve packing solutions by between 5 and 15%.

For one client this level of improvement means that its warehouse uses two fewer pallets each day. Over the year this adds up to a considerable cost saving.

Mr Aggoun also describes how rapid optimisation has a massive knock-on effect across an entire logistics operation. 'In most warehouses today you don't know until you've finished packing exactly how many pallets you are going to ship. That means you can't confirm with the transport company the size of vehicle they need to send until the very last moment.'

Using the KLS Optim software, you know exactly which products are going to be packed and in which pallets. Within a minute of receiving an order you can already be contacting the logistics provider to book space for a specific number of pallets.'

Although optimisation software does already exist, KLS Optim has a compelling proposition. Licences for competitive products cost around EUR 20 000, but Mr Aggoun says that his software will cost between EUR 3000 and EUR 10 000. 'As part of the Net-WMS project we identified different classes of problem. We developed a dedicated engine for each class. So you only need to buy the module for your class of problem — and that saves you money.'

Other industrial partners in the project, in particular Peugeot Citroen Automobiles and Fiat's research centre, are backing a follow-on Seventh Framework Programme project which they hope will look at more refinements to the work completed by Net-WMS. In particular, the tools need to be refined to improve on solutions for packing complex, irregular shapes (e.g. car silencers). User-interfaces also need to be improved, for example to explain why sometimes no solution can be found.

The algorithm will also be adapted for tools that will be used to plan how to cut shapes in a two-dimensional sheet, stack shelves and even optimise production schedules.

Net-WMS received funding from the ICT strand of the EU's Sixth Framework Programme for research.

⁽¹⁾ One to force it with a hammer, four to go out and buy another bulb!

⁽²⁾ 'Towards integrating virtual reality and optimisation techniques in a new generation of networked businesses in warehouse management systems under constraints.'

Promoted through the ICT Results service.

<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91213>



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Exciting new road transport scheme on track

An EU-funded project is developing and testing new technologies to enable vehicles to travel together safely in 'road trains' on unmodified public motorways.

The 'Safe road trains for the environment' (Sartre) project brings together a unique mix of technologies, skills and expertise from European industry and academia, with the aim of developing safe and environmentally efficient road trains.

'By working at vehicle level, Sartre aims to realise some potentially very significant safety and environmental benefits without having to invest in changes to road infrastructure,' according to the project coordinator Tom Robinson of Ricardo UK Ltd.

Mr Robinson says the project is encouraging a step change in personal transport usage. Under this innovative scheme, a professional driver in a leading vehicle will take responsibility for a 'platoon'. Following vehicles will operate in a semi-autonomous control mode, allowing their drivers to do other things such as operate phones, read books, eat or watch movies.

'Many people feel this sounds like Utopia,' admits Erik Coelingh, technical director of the 'Active safety functions' at Volvo cars. 'However, this type of autonomous driving doesn't require any hocus-pocus technology, and no investment in infrastructure.' Instead, he explains, the emphasis is on adapting existing technologies.

Each platoon will have a lead vehicle that drives completely normally. The driver of

the lead vehicle would ideally be highly experienced and thoroughly familiar with the route. This lead vehicle could be a taxi, a bus or a truck. A platoon would consist of six to eight following vehicles. A driver in a following vehicle approaching his or her destination takes over control of the vehicle and leaves the convoy by exiting off to the side. Other vehicles in the platoon close the gap and continue on their way.

Crucially, the project includes a comprehensive testing programme to meet high safety demands.

Sartre project partners say concrete benefits are to include:

- increased safety — following drivers in the convoy can get on with other business while on the road, for instance when driving to or from work;
- reduced environmental impact — lower fuel consumption compared with cars being driven individually; because they are close to each other, air drag is significantly lower (energy savings are expected to be around 20%);
- more efficient use of road capacity.

The first cars to be equipped with the new Sartre system could appear on test tracks as early as 2011. The vehicles will be fitted out with a navigation system and a transmitter/receiver unit that communicates with the lead vehicle.

Key initial tasks for the project include analysis of platooning strategies and human behaviour, and definition of system components and modules, and how they are connected on each vehicle. As the system will be completely contained within the cars, there will be no need to modify existing road network infrastructure.

The Sartre project is supported under the European Commission's Seventh Framework Programme (FP7). Other partners include Spain's Idiada and Robotiker-Tecnalia, Germany's Institut für Kraftfahrwesen Aachen, and Volvo's SP Technical Research Institute in Sweden.

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<http://ec.europa.eu/research/infocentre> > search > 15313



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Bigger losses at sea... no more

The dramatic sinking of the two tankers, Erika and Prestige, off the coasts of France and Spain were a clarion call for better shipping safety measures in and around Europe's waters, from more robust inspection regimes to more advanced vessel traffic management.

Europe has seen first-hand two major shipping disasters in the past decade leading to untold environmental damage and huge cleanup costs. The Erika, which sank in rough waters off the coast of Brittany in 1999, and the Prestige, which broke up off the Galician coast of Spain in 2002, were painful reminders of the need for more robust traffic management and safety measures for shipping.

In the Prestige case, many believe the disaster could have been avoided had there been better communication between relevant authorities, as the stricken vessel sailed up and down the coast of Spain, France and

Portugal in search of refuge, before eventually breaking up and releasing its heavy fuel cargo into the sea.

To prevent repeat events like this, a swathe of national and European initiatives were launched, notably the 'Erika package', leading to a more joined-up, proactive approach to maritime transport in Europe, with better services and smarter communications and safety technologies and platforms.

For its part, the European Commission promoted the development of 'e-maritime', a meeting of services and systems, in response to the need for a more transparent and har-

monised approach within the maritime sector. The Commission's stated aim was to 'bring about a change in the prevailing mentality in the seaborne oil trade' in particular.

The European project 'Maritime navigation and information services' (Marnis) goes a long way to supporting the Commission in its e-maritime ambitions. The four-year Marnis project, funded from 2004 to 2008 by the Sixth Framework Programme (FP6) for research, focused on improving the exchange of information from ship to shore, shore to ship and between shore-based stakeholders — authorities and businesses.

By necessity, Marnis' work has cut across a range of activities, from improving security, safety and environmental measures, to boosting the efficiency and reliability of maritime transport, and helping to harmonise the legal and organisational aspects of the sector. It developed an e-maritime plat-

form, including maritime operational services (MOS), Safeseanet++, single window/electronic port clearance (EPC), and Marnis node and port community systems (PCS) and broadband platform.

While there is a recognised need for more proactive management of vessel traffic in all EU waters, Marnis acknowledged that this needs to be achieved without increasing the administrative burden on vessel managers and crews. This is where smarter and more streamlined vessel traffic management (VTM) technologies and procedures are important.

Local and regional authorities have made good use of various VTMs in their coastal networks, according to Marnis, but developing a pan-European 'one-stop-shop' management system is an altogether more complex task, involving diverse standards bodies, policy-makers, customs officials, maritime authorities and stakeholders across Europe.

'The framework for seamless reporting as a basis for "one-stop-shopping" is available, but national and international efforts are required to bring all stakeholders and actors

together to build up and link all elements required to establish a pan-European system,' notes the Marnis consortium which is made up of more than 50 partners and sub-contractors, among them leading transport and logistics groups, port authorities across Europe, associations, and research centres.

The suite of solutions and tools developed by Marnis manage to harness existing technologies, while allowing for the emergence of new technologies. And it has managed to

galvanise relevant authorities and actors behind the European Maritime Directive, helping to describe its organisational and legal structure.

Created with the Transport Research Knowledge Centre and Marnis consortium.

Marnis was funded under the FP6 thematic area Sustdev-2 (Sustainable surface transport).
<http://www.transport-research.info> > projects & analysis > search > marnis



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Biomarkers for the North Sea oil industry

Water and sediment samples were collected from methane gas seeps and pockmarks in the North Sea. The samples were analysed for microorganisms, the DNA of which could be used as biomarkers by the oil exploration industry.

The project 'Methane fluxes in ocean margin sediments: microbiological and geochemical control' (Metrol) studied the role of the important greenhouse gas methane in selected ocean margin sediments.

Project partners Statoil ASA based in Trondheim, Norway, investigated water samples taken from above methane gas seeps and craters in the seabed known as pockmarks. Some samples were collected at different depths from the same location. Corresponding sediment samples were also gathered near the seep and at the site of the pockmark. The sampling was carried out in the areas of Tommeliten, Kvitebjørn and Holene in the North Sea.

Researchers analysed microbial diversity in the water samples using cloning, gene sequencing and DNA amplification techniques. Samples were measured with a flow cytometer to ascertain the size distribution of minute particles between 200 to 600 nanometres in diameter. A range of staining techniques were also applied to

the particles which revealed that the majority of microorganisms were dead when they arrived onshore.

Water samples were analysed using denaturing gradient gel electrophoresis (DGGE), which showed that the microbes present differed according to their location and sampling depth. Sediment samples were examined using restriction fragment length polymorphism (RFLP) which also

indicated differences between sampling sites. Genome mapping and sequence analysis were employed to analyse the sediment samples and ascertain the distribution of bacterial and archaeal groups within the microbial community.

Researchers used the results of the DNA analysis to draw up a phylogenetic dendrogram to help understand the evolutionary relationships and possible origins of the microorganisms. The DNA data was also compared to gene banks for a possible match and used as specific markers in the analysis of samples from other locations including those connected with oil exploration.

The work undertaken by the Statoil team revealed previously unknown gene sequences, which indicated the presence of new species of microorganisms. The results also showed differences in the microbial population according to location and between water and sediment samples. The findings from the Metrol project can assist in the search for oil and increase the level of knowledge of oil-associated microorganisms.



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Funded under the FP5 programme EESD (Energy, Environment and Sustainable Development).
 Collaboration sought: further research or development support.
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Resolving biomass gasification wastewater issues

The results of a number of experiments performed by chemical engineers in Italy may help resolve the wastewater issue that is currently impeding the adoption of biomass gasification.

Gasification of biomass holds the promise of producing energy from sustainable sources while at the same time emitting significantly fewer greenhouse gases to the atmosphere. One challenge that must be met concerns the management of the highly contaminated effluent produced during the de-tarring process.

The participants in the 'Degradation of tarwater from biomass gasification' (DE-TAR) project investigated the potential of a treatment process involving supercritical water oxidation (SCWO) and gasification (SCWG). A key contribution was made by the Università degli Studi di Napoli "Federico II" (UNINA) concerning the modelling of chemical kinetics of SCWO/G.

A first-order Arrhenius reaction was used to describe changes in the total organic carbon (TOC) content of tarwater. Isothermal and isobaric plug flow was assumed. Using

this approach, the UNINA scientists could obtain the kinetic rate constant for a variety of conditions reproduced in the laboratory.



It was then possible to derive the other critical components of the relevant chemical equation.

A primary objective of the research was to evaluate the ability of catalysts to reduce TOC content. Additional assumptions regarding activation energy, temperature and mass conservation were made in order to determine the pre-exponential factor. In this way, the relative contributions of catalysts such as active carbon, potash and ammonia, were assessed.

The knowledge acquired from these experiments was applied during the development of the DE-TAR pilot biomass gasification system.

Funded under the FP5 programme EESD
(Energy, Environment and Sustainable Development).
Collaboration sought: further research
or development support.
<http://cordis.europa.eu/marketplace> >
search > offers > 5276

See also page 38 'Pilot reactor for treating wastewater with ozone'

Exploiting hot dry rocks to provide carbon-free energy

In its search for sources of cleaner energy, Europe is leaving no stone unturned, including very hot stone found at a depth of several kilometres below the Earth's surface.

The European economic interest grouping (EEIG) 'Heat mining' led a consortium of several research institutes in a major drilling project in Soultz, located in north-eastern France.

The resulting 'Hot dry rock energy' project's aim was to exploit heat contained in the Earth's crust to produce energy without emitting greenhouse gases to the atmosphere.

Extensive drilling in wells GPK3 and GPK4 lasted several months and cost several million euro per well. While the project's initial drilling targets were achieved, some technical difficulties were encountered. This included well over 1000 metres of horizontal drilling to maintain the necessary separation between the injection and production wells.

Advantageous physical characteristics of the rock underlying Soultz were complicated by the risk of microseismic activity in the region. It was necessary for the 'Hot dry

rock energy' participants to strike a balance between these factors when deciding where to position the wells. In the end, they opted for a compromise between shear stress and maximum compression.

Important feedback was gathered during the drilling campaigns. For instance, it was noted that the intense heat caused problems with electronic components of the measure

while drilling (MWD) system. High pressure and vibrations also led to instances of mechanical failure. On a positive note, the drill bits performed better than expected with lifetimes consistent with those associated with less challenging drilling applications.

EEIG and its 'Hot dry rock energy' partners aim to build upon this experience during the next phases of the construction of a pilot power plant at Soultz.

Funded under the FP5 programme EESD
(Energy, Environment and Sustainable Development).
Collaboration sought: further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5286



Microscopic gyroscopes, the key for motion sensing

Tiny devices made possible by combining the latest advances in mechanical and electronics technology could be at the heart of next-generation personal navigation and vehicle stabilisation tools thanks to European researchers.

Most people know what a gyroscope is and probably played with one as a child. Get the centre ring revolving at high speed using a length of string or piece of plastic, put the frame on a stand and watch it apparently defy gravity.

But as well as being one of the most enduring toys of the past century, the gyroscope has many practical applications. The first was as a gyrocompass for shipping, replacing traditional, less reliable, magnetic compasses, and then as a stabiliser in ships and aircraft and more recently spacecraft.

In recent times, the focus has switched to attempts to miniaturise gyroscopes, or to reproduce the gyroscopic effect in very small structures, so as to provide mass-market applications to consumers.

The aim was partially achieved with the development of tiny micro-electro-mechanical systems (MEMS) underlying the gyroscopes. However, in order for them to have mass commercial potential, it was necessary to come up with a way of securely and cost-effectively packaging them to insulate and protect them from the external environment.

The EU-funded project 'Downscaled assembly of vertically interconnected devices' (DAVID) was set up to do just this, with six partners from five countries looking at ways to reduce assembly and packaging costs for mass-produced hybrid integrated devices comprising both mechanical and electronic components.

The MEMS are bonded to electronic systems-on-chips or application-specific integrated circuits (ASICs), powerful micro-components which run devices such as mobile phones and gaming consoles. Large numbers of ASICs are mass produced by being 'etched' onto silicon wafers in sophisticated, ultra-clean wafer fabrication plants.

Project coordinator Norman Marengo explains the challenge: 'To create a gyroscope effect for measuring motion in a vehicle or even a pedestrian, you have to provide a moving structure inside a very, very small device and this means combining the mechanical movement with some very sophisticated electronics.'

'As the device will be embedded in a vehicle electronics system, or even eventually a mobile phone, it needs to be self-contained and continue operating for many years.'



What this means is the moving parts will be oscillating continuously. In theory, they would ideally be in a vacuum so there is no resistance to the movement, but in practice a small amount of air pressure is needed to avoid disturbance so the conditions are near vacuum. To maintain this state indefinitely, strong and durable packaging which individually seals off each device is a must.

To create the devices, the MEMS are bonded directly onto ASICs resulting in very short interconnections between the mechanical and electronics structures to produce the best possible signal quality. The bonding can be done using either a chip-to-wafer (C2W) or wafer-to-wafer (W2W) approach, but due to the large number of chips per wafer the only cost-effective way to go into mass production is the latter and so this is what the researchers and industrial partners worked towards.

So complex was the procedure, but so promising the initial results, the project was given a six-month extension until mid-2009 with a final report being published in September, by which time full wafer samples had been produced. A mould tool for six-inch wafers was developed and various mould compounds tried out to find the ideal encapsulation for the chips on the wafers.

Now the project has managed to prove it is possible to mass-produce the MEMS/ASIC devices and hermetically seal them, industrial partner STMicroelectronics, a major chip manufacturer, has started work on a high-volume manufacturing approach using W2W integration.

Mr Marengo predicts that, by 2012, the MEMS gyroscopic devices could be in mass production, initially for mobile phone applications. 'You could have tiny devices embedded in mobile handsets that respond to movements made by the users so it is possible to keep exact track of the movements of somebody walking around. For human-machine interfaces and personal navigation systems you need to be able to track motions in three dimensions very precisely, which is what these devices can do,' he says.

Another potential mass-market application is stabilisation systems for motor vehicles, although this is not something the project studied in any depth.

Funding has now been sought for a follow-up project to try and develop a broader base of sensors for a wider range of applications, such as automotive ones. 'Most of the partners from DAVID want to continue down this path and concentrate more on applications now the initial proof-of-concept work has been done. We also want to get more equipment suppliers involved, companies making devices like endoscopes and night vision products,' he says.

The DAVID project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

Promoted through the ICT Results service.
<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91050>

Energy savings

Trials are being conducted for a new system to monitor the real-time energy consumption in the household. The data is measured, processed and displayed, showing users how much power is being consumed by various electrical appliances. These efforts are part of a European Union research project that is creating new ways to allow consumers to follow and better understand their use of energy.

In a family home, on the outskirts of Helsinki, sensors were installed on various electrical devices. By observing their energy consumption on a laptop or a touch-screen mobile phone, they were able to see, for example, that cleaning the freezer led to a 15 % energy reduction via defrosting.

Giulio Jacucci, coordinator of the project 'Boosting energy awareness with adaptive real-time environments' (Be aware), is responsible for the software being used. The system is called 'Energy life' and utilises mobile phones to raise energy awareness. Users can see on their mobile phone display the energy consumption for individual electrical devices, as well as for the whole house, and can see whether devices in the home are turned on or off, or if more energy is being used than in the past.

A crucial phase of the software development is making it user-friendly. Trials have shown that the software is best received with a 3D interface with touch-screen, mimicking a natural interaction. However, finding the right language to label the information, so that it is easily understood, has proven to be difficult.

Each software update is followed up with about 20 tests with volunteers at the University of Padua in Italy, a 'Be aware' partner. How the volunteers interact with the software is recorded and analysed by the psychology professor Luciano Gamberini and his team using different methods, like structured video analysis. They then send the engineers feedback explaining where the volunteers are having difficulties.

Professor Gamberini's team has also been looking into the attitudes people have to energy saving. Written questionnaires suggested that people in most cases have very good habits concerning energy use. However, when using a lie detector test, the statistics took a different form: almost half of the people gave untruthful responses to questions regarding sustainability (for example, leaving the lights on).

For the 'Energy life' system to be widely accepted, it has to be able to deliver infor-

mation in a very clear and concise manner. This will mean that, rather than waiting half a year for the energy bill, users can see precisely where the energy is being used, and ultimately decide whether this energy use is really necessary. Researchers estimate that home-owners will be able to reduce their energy costs by 15 %.

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<http://ec.europa.eu/research/infocentre> > search > 15334



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Written questionnaires suggested that people in most cases have very good habits concerning energy use. However, when using a lie detector test, the statistics took a different form: almost half of the people gave untruthful responses to questions regarding sustainability.



The buzz on the decline of the honey bee

World-renowned physicist Albert Einstein once said: 'If the bee disappears from the surface of the Earth, man would have no more than four years to live. No more bees, no more pollination, no more men!' What is being done about the demise of Europe's bee populations?

A team of scientists has found that the number of bee colonies in central Europe has shrunk over the years, and the number of beekeepers in Europe has declined since 1985. The findings, presented in the *Journal of Apicultural Research*, add weight to an escalating problem.

The results are part of the EU-funded 'Assessing large-scale environmental risks with tested methods' (ALARM) project, which received more than EUR 12.5 million under the 'Sustainable development, global change and ecosystems' thematic area of the Sixth Framework Programme (FP6).

The study's findings are significant because they cover the majority of Europe, not just individual countries. According to the researchers, the honey bees are not alone in their fight for survival; wild bees and hoverflies are also feeling the pressure. The results show that pollinator services will feel the crunch, and in turn so will arable crops.

The scientists evaluated data that were made available from national reports and beekeeper magazines to determine the overall number of bee colonies and beekeepers. Based on these records, the team reconstructed bee colonies between 1965 and 1985 for 14 European countries, and between 1985 and 2005 for 18 European countries (except Spain, France, and some eastern EU Member States).

Their findings reveal that both western and central Europe have been sustaining losses in the number of bee colonies since 1965. The Czech Republic, Norway, Slovakia and Sweden have also been reporting dwindling numbers since 1985. On a positive note, however, southern Europe and in particular Greece, Italy and Portugal reported increases in the number of colonies between 1965 and 2005.

Most scientists speculate that social and economic changes are responsible for the decline; beekeeping as a hobby is not what it

used to be. Manual labour gave way to machines, and rising incomes of the rural population made products that were based on sugar better suited for everyone's pockets.

'The price of treating bee diseases has increased to the extent that the cost of treatments may equal or exceed the income from a colony for an entire year, thus making it uneconomic to keep bees on a small scale,' says lead author Dr Simon G Potts of the University of Reading in the UK. 'Moreover, the effort for treating disease, in particular *V. destructor* [*Varroa destructor* is an external parasitic mite that attacks honey bees], has probably also reduced the attractiveness of beekeeping as a hobby.'

Despite the results of the study, more research is needed. 'With the limited evidence available it is neither possible to identify the actual driver of honey bee losses in Europe nor to give a complete answer on the trends for colonies and beekeepers,' explains co-author Dr Josef Settele of the Helmholtz Centre for Environmental Research (UFZ) in Germany. 'This obviously creates an urgent demand for a standardisation of evaluation methods, especially on colony numbers. Such harmonised reliable methods will be the obvious backbone for any research to understand and mitigate honey bee colony losses.'

Led by Dr Settele, the ALARM project brought together more than 200 researchers from 35 countries and 68 partner organisations.



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Phytoplankton and nutrient levels in the Baltic Sea

Thanks to benchmarks established during the SIBER project, it will be easier to assess future changes in the chemical composition of the Baltic Sea, including the effectiveness of measures aimed at restoring the status quo.

The eutrophication of rivers that feed into the Baltic Sea and other types of human intervention have significantly reduced the amount of dissolved silicate (DSi) reaching the sea. This in turn has impacted the coastal and marine ecosystems, especially organisms like phytoplankton that rely on DSi as a basic nutrient.

A group of local research institutes set out to provide the relevant authorities with the knowledge necessary to promote sustain-

ability. An essential step involved gathering data to establish baseline conditions for the Baltic Sea, a natural resource of significant value to the region.

The investigation was led by the Baltic Sea Research Institute in the context of the 'Silicate and Baltic Sea ecosystem response' (SIBER) project. Samples were collected from a number of different locations in the Baltic Sea. The analysis culminated in the creation of a database of

phytoplankton composition, with an emphasis on diatoms, for the period 1979 to 2005 and a database of nutrient concentrations, including DSi, covering the entire 20th century.

The approach employed by the SIBER research consortium was consistent with the requirements of the 'Water framework directive', an important piece of legislation aiming to protect water quality. The databases will be made available to the relevant authorities to assist policy-making at both national and European levels.

Funded under the FP5 programme EESD (Energy, Environment and Sustainable Development).
Collaboration sought: information exchange/training.
<http://cordis.europa.eu/marketplace> > search > offers > 5296

Modelling the behaviour of European fishermen

Valuable insight into the way in which fishermen make professional decisions was obtained during a ground-breaking European research project.

The behaviour of fishermen is a crucial factor influencing the industry as a whole, yet very little research has focused on this subject. Due to data collected during the project 'Technical developments and tactical adaptations of important EU fleets' (Tectac), which brought together nine research institutes from five different EU Member States, this situation has changed.

Scientists with the University of Portsmouth in the United Kingdom led to the implementation of empirical modelling approaches to fishermen's decision-making processes. The inquiry addressed choice of species, equipment and location as well as issues related to compliance with fishing policies and withdrawal from the profession.

Data was collected through a number of case studies which assessed a large sample of fishermen from fleets operating off the

coasts of Denmark, Spain, France and the United Kingdom. An agent-based model was attempted, but in the end a random utility model proved the most appropriate to describe the fishermen's behaviour. This was supplemented with feedback from separate analyses of the effect of fuel prices and area closures on their decision making.

The team at the University of Portsmouth has shared these results with the academic community through conference proceedings and journal publications. The findings were also incorporated into simulation models developed during later stages of the Tectac project.

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).
Collaboration sought: Further research or development support
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Airmex cautions indoor pollutants are too high

EU-funded research shows that many harmful air pollutants make their presence known more indoors than outdoors.

The 'European indoor air monitoring and exposure assessment project' (Airmex) investigated indoor air quality and personal exposure concentration by measuring 19 volatile organic compounds in indoor air, such as carbonyls, terpenoids and aromatics, in public buildings and kindergartens in a number of cities across Europe. Airmex is funded under the EU's Joint Research Centre (JRC).

Improved health is a priority for the EU, and this is outlined in the 'European environment and health action plan 2004-2010' which focuses on determining what impact

environmental damage has on human health. This action plan will give the EU the information it needs to forge stronger collaboration between stakeholders in the environment, health and research fields.

The Airmex partners found that personal exposure concentrations to harmful pollutants — especially formaldehyde and benzene — are for the most part higher than the respective indoor/outdoor concentrations.

Their research also showed that 30.2 % of the personal exposure concentrations, 22.9 % of the indoor concentrations and 18 % of the outdoor concentrations topped the ambient air limit value established by the European Commission for 2010 under directive 2000/69/EC for benzene.

According to the researchers, these values are above health benchmarks. The outdoor con-

centration measurements single-handedly underestimate the health risks from human exposure to the values in the long run.

The researchers evaluated how human lung cells are affected by the mixtures of chemicals. Based on their data, the chemical compounds interact and their impact on human health is contingent on the presence of other chemicals. On the whole, the results indicate that the multiple effects of indoor air pollutants depend on other components that affect people, including stress, gender and genetic background.

Ultimately, the Airmex project identified and quantified the main air pollutants in various areas and identified the main sources of these pollutants. It estimated human exposure and assessed how human health that is exposed to these pollutants is affected, in particular the well-being of children.

The researchers performed analyses in Brussels (Belgium), Nicosia (Cyprus), Athens and Thessaloniki (Greece), Leipzig (Germany), Catania and Milan (Italy), and Arnhem and Nijmegen (the Netherlands). The full project also included the cities of Dublin (Ireland), Budapest (Hungary), and Helsinki (Finland).

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Protecting our children from noise pollution

The results of a recent study highlight the need for strong policy and decisive action to protect children from the detrimental effects of noise pollution.

It has long been thought that noise may affect learning in children. Substantial funding was set aside by the EU's 'Life quality' programme to investigate this further. One such study, the RANCH⁽¹⁾ project, focused on children at schools in the vicinity of three major European airports.

Information about noise levels, from not only aircraft but also road traffic, was collected from existing contour maps, measurements at schools and analysed using noise models. Standardised tests were then carried out to measure the children's ability to retain information (episodic, working and prospective

memory), their sustained attention and reading comprehension. Nearly 3000 children from some 90 schools participated in RANCH.

The effects of aircraft and vehicle noise were analysed separately and in combination. This approach helped bring to light the complex interaction between the two main sources of noise pollution in urban areas. For instance, road traffic noise affected episodic memory while aircraft noise did not. On the other hand, the RANCH participants demonstrated that aircraft noise clearly delayed reading age. A combined effect was identified in the case of reading comprehension.

The use of the neurobehavioural evaluation system (NES) allowed the researchers to evaluate the impact of noise on a range of other cognitive parameters. Although no effects upon motor function and perceptual coding were detected, attention and reaction time were impaired by both types of noise. In fact, a complicated feedback mechanism between aircraft and road traffic noise was discovered.

In general, the RANCH findings confirm that noise pollution impairs the proper cognitive development of children.

⁽¹⁾ 'Road traffic and aircraft noise exposure and children's cognition and health: exposure-effect relationships and combined effects.'

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).

Collaboration sought: further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5345

Innovative approach to seismic hazard assessment

Some regions will always be prone to earthquakes. The hope is that scientific study can shed light on how to limit the loss of human life associated with these natural disasters.

Extensive surface rupturing triggered by two severe earthquakes in western Turkey in 1999 caused significant damage and cost thousands of lives. A multinational team, supported by the EU's 'Energy, environment and sustainable development' programme, visited the site to collect data with the aim of improving seismic hazard assessment in the region.



Geophysicists with the Swiss Federal Institute of Technology Zurich participated in the project, entitled Relief⁽¹⁾. They applied their expertise to better address the impact of complex geometry on surface rupturing in seismic modelling. Another important contribution

entailed the use of realistic heterogeneity in the treatment of rate and state friction.

A fresh evaluation of the threat of further significant earthquakes affecting this region, namely the nearby capital Istanbul, was performed with the updated models. It

marked the first time ever that earthquake cycle models were combined with those designed to predict ground-motion.

The results of the simulations were remarkably consistent with the type of earthquakes that have been observed to date in the region. This held true not only for the slip characteristics of the events, but also for their distribution in time and space. Finally, with respect to surface rupturing, the revised models were able to successfully reproduce important differences between young faults and their more mature counterparts.

⁽¹⁾ 'Large earthquake faulting and implications for the seismic hazard assessment in Europe: the Izmit-Duzce earthquake sequence of August-November 1999 (Turkey, mw 7.4, 7.1).'

Funded under the FP5 programme EESD (Energy, Environment and Sustainable Development).

Collaboration sought: further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5280

High-tech tools help sniff out volcanic gas

A European project is creating a network for the measurement of volcanic gas emissions. The data is to be used for volcanological research and risk assessment, to minimise the threat posed by eruptions. Measurements are collected across five continents from some of the most active volcanoes in the world.

The village of Armero in central Colombia was annihilated on the 13th of November 1985 by the Nevado del Ruiz volcano. As the eruption melted 8% of the glacier situated upon the volcano, it caused a massive mudslide that engulfed the village, killing about 23 000 people.

Nowadays the Nevado del Ruiz volcano is keeping quiet, but it is still active. Geological deformation, electromagnetism or seismic activity can be useful in predicting whether an eruption may be imminent or not. The various craters of Nevado del Ruiz are regularly monitored by volcanologists, who use

measurements of volcanic gas to make their predictions. Sulphur dioxide is particularly important for the scientists.

The level of sulphur dioxide being emitted from the volcano can be an indicator for magma activity below the surface. Ordinary daily emissions of sulphur dioxide for a volcano like the Galeras, in southern Colombia, range from 1000 to 3000 tonnes.

This can jump to 15 000 tonnes when magma rises to the surface. It is then at the point, when the magma blocks all cavities in



the surface and sulphur dioxide is no longer expelled, that an eruption may take place.

Gustavo Garzón and his colleagues of the Colombian Institute of Geology and Mining have always climbed the Nevado del Ruiz to manually measure the flux of sulphur dioxide. Yet the climb is not always successful; low visibility and unstable snow-covered terrain can make the journey too dangerous.

To this purpose the EU-funded research project 'Network for observation of volcanic and atmospheric change' (NOVAC) is devising a way to safely deliver real-time measurements of sulphur dioxide. Bo Galle is a Swedish physicist and coordinator of NOVAC. His team from Gothenburg have developed a prototype to monitor volcanic gas without having to make the risky climb to the cra-

ter. The prototype utilises new computing, optical spectroscopy and camera technology. The telescope within the unit is connected to a rotating mirror so that the volcanic gas plume that is emitted from the crater can be observed in different directions.

The measurements are processed into data by the computers within the unit and sent by radio to observatories below. Developing a prototype that could withstand the large temperature fluctuations, storms, acid-rain and ashes from the volcano was very difficult for the research team. Because of the location of the installation, it must also be robust and require a minimum amount of maintenance.

More than 20 active and potentially dangerous volcanoes around the world, including two other Colombian volcanoes, now have

such gas monitoring devices. Recent eruptions in Colombia have already been accurately predicted.

It was just a few years ago that several volcanologists were killed while measuring gas emissions in the Galeras volcano crater. Now volcanologists can safely use the data provided by the NOVAC project's prototype, which is updated every five minutes, for risk assessment. During the eruption of Nevado del Ruiz in 1985, the people were helpless. Today the constant flow of data provided could prove pivotal in saving human lives.

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See also page 13 **'Sensors for the harshest of environments'**

Combating biofouling with ultraviolet light

The loss of valuable research data to biofouling may become a thing of the past thanks to a solution proposed by the University of London that is based on commercially available technology.

Microorganisms, algae and other marine residents accumulate on scientific instruments that remain submerged in the ocean for an extended period of time. This phenomenon is called biofouling and it negatively impacts the quality of data collected during long-term measurement campaigns.

The 'Biofouling resistant infrastructure for measuring, observing and monitoring' (Bri-mom) research consortium received support from the EU's 'Energy, environment and sustainable development' programme to

develop and test instrumentation resistant to biofouling. One approach involved the use of short-wave ultraviolet light, known as UV-C, which has proven germicidal properties. The research was overseen by scientists with the University Marine Biological Station of the University of London.

The effectiveness of low-pressure UV-C lamps of varying intensity was analysed in a laboratory setting. The experiments revealed that it was possible to successfully limit biofouling by pulsing relatively

low levels of UV-C light through a special optical window onto the instrument surface.

Furthermore, although the technology is not yet fully mature, UV-C lamps based on light-emitting diodes (LEDs) may be able to offer the same benefits with lower power requirements and simpler configurations. The University Marine Biological Station scientists have shared these results with the research community through dedicated publications.

Funded under the FP5 programme EESD
(Energy, Environment and Sustainable Development).
Collaboration sought: further research or development support.
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Harmonising policy to combat desertification

At the heart of a programme concentrating on finding strategic solutions to the problem of desertification is the way in which policy-makers address the issue. One research team, with the Mediterranean as a test-bed, has created an aid which can be used to assess the impact of existing and future policies on desertification.

Combating land degradation and desertification is a struggle against the loss of biological productivity due to climate changes and human activities. Unsustainable land management is at the centre of this struggle and it is the role of policy-makers at local and

international level to help change this. This socio-environmental problem is one in which policy-makers play a key role in managing its natural and institutional complexity.

Researchers under the umbrella of the EU project 'Policies for land use to combat desertification' (Medaction 4) developed a general approach to systematically analyse potential policy problems relating to desertification. Using this method as a basis, stakeholders are able to break down the content and structure of a policy and link it to policy objectives, the actors involved, and ways it is being implemented.

The intention is that the methodology be used as an aid by public sector organising bodies which are responsible for policy-making at EU and national level. Current application of the methodology has focused on testing existing policies for the contribution they make, be it directly or indirectly, to desertification. Evaluations of these existing policies, such as those concerning regional and rural development, tourism and economic policies were conducted using case studies in regions in Greece, Spain, Italy and Portugal.

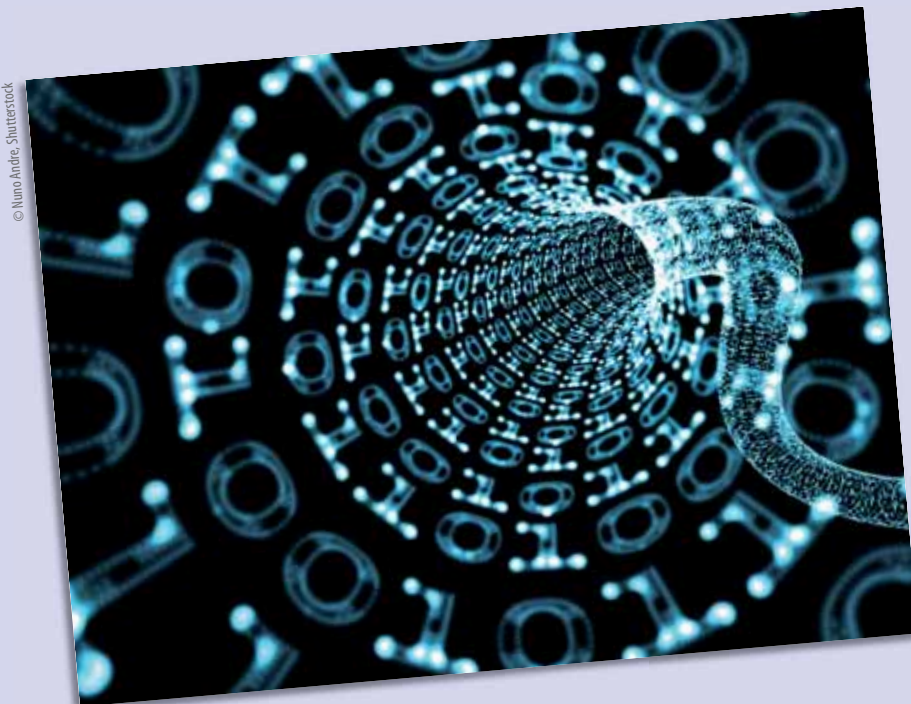
Using this method it is hoped that all the stakeholders involved or impacted upon by desertification policies, will benefit from the provision of mutually supportive and non-conflicting policies.

Funded under the FP5 programme 'EESD'
(Energy, Environment and Sustainable Development).
Collaboration sought: further research or development support.
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Machine-learning revolutionises software development

Automation technology has revolutionised the fine-tuning needed to maximise software performance on devices such as mobile phones.



compiler that can work across any future architecture configuration.'

The Milepost GCC technology learns to predict the optimal compiler solution for any new program by analysing the execution time of various compiler options and the amount of code in their training programs.

The key technical challenge for the Milepost team was to describe programs and hardware in ways that machine-learning technology could use. That also meant completely redesigning compilers to enable them to use the new machine-learning technology.

Better software performance can open up new opportunities for product suppliers, explains Mr O'Boyle. 'If you can run things faster and more energy efficiently, you may be able to choose a different piece of hardware than before

— perhaps a cheaper option for the same performance. Alternatively, you could add more functionality without increasing energy usage. You get more for your money.'

French company CAPS Enterprise SAS, one of the participants in the EU-funded Milepost project, planned to include Milepost technologies in its new set of tools. Other participants, including IBM, are using Milepost GCC to get better performance from their processors, making their products more attractive to customers.

The Milepost team has launched a code tuning website for the compiler development community. Developers can upload their software code to the site and automatically get input on how to tune their code so it works faster.

'This is one of the most successful projects I have been involved in,' says Prof O'Boyle. He and his fellow researchers are now seeking to apply the lessons of Milepost to help solve the challenges of next-generation computer technologies.

'We can use machine-learning technologies to look at multi-core and heterogeneous platforms and we will be looking at dynamic online adaptation,' he says.

But as workloads change, can hardware and software be reconfigured to make it adaptable to the fine grain and big scalability challenges we will have when we move from 2, 4 or 8 cores to thousands of cores on a chip?

This is the big question facing developers of the future. And the smart money will be on the Milepost researchers to answer it.

The Milepost project received funding from the ICT strand of the Sixth Framework Programme for research.

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<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91208>

Application developers for software on mobile phones and other embedded devices can achieve acceptable performance levels 10 times faster thanks to a breakthrough by European researchers.

Human-readable software code needs to be translated into binary code by a compiler if it is to run on hardware. When hardware is upgraded the software's compiler usually needs to be tweaked or 'tuned' to optimise its performance. If compilers are not optimised for the hardware, doubling the processor size or increasing processor speed can actually result in a loss of software performance, not an improvement.

But hardware is changing so quickly compiler developers are struggling to keep up and compiler optimisation has become a bottleneck in the development process.

Using machine-learning technology, researchers on the project 'Machine learning for embedded programs optimisation' (Milepost) have developed an automatic way to optimise compilers for re-configurable embedded processors. Whether it is mobile phones, laptop computers or entire systems, the technology automatically learns how to get the best performance from the hardware and the software will run faster and use less energy.

'All the compiler teams at the big companies are rethinking the way they do things as a result of this,' says Professor Michael O'Boyle, from the University of Edinburgh, and project coordinator for Milepost.

'Automation provides compiler developers with leverage to be more experimental. They can try new ideas, new analyses and new optimisations. The machine-learning technology analyses whether it works and when it works. It opens up a whole new area of research and a whole area of performance gains that we couldn't try before. For instance, we were able to deliver a portable

Assembly line reaches software

The assembly line created by Henry Ford in 1908 revolutionised manufacturing, and now European researchers are perfecting the same concept for software.

European researchers have created tools and techniques to make possible an assembly line-style development process for software.

'In a nutshell, think of this as a sandwich shop, where you have different products coming from a product line that shares ingredients, which customers can pick and choose,' explains professor Awais Rashid of Lancaster University and coordinator of the project 'Aspect-oriented, model-driven, product line engineering' (AMPLE).

Instead of sandwich ingredients the asset base contains modular software components creating a software product line (SPL). The components come in a large number of variations, and the whole software life-cycle — from design, development through implementation and maintenance — is managed in the SPL.

This approach also offers forward and backward traceability, a way of following code, and program elements to see how they relate and affect other parts of the system. This kind of traceability means that upgrading and redevelopment is much faster, cheaper and more accurate.

The AMPLE team went much further however. They developed analyses tools that tell users how to develop their system. It is a very powerful technique.

There are two scenarios. In the first, a company already works in an area and has a range of products, and makes the business decision to move its development process to the SPL model.

Here, the analyses software will look at the existing assets — the existing software specification, its documentation and feature list. From that analysis it can create a feature list that tells the business what it needs to create its new SPL.

In the second scenario, a company decides it will start to develop software for new applications. It could be an existing business or a start-up. The analyses tool will scan relevant documents and spec lists to reveal what elements their new system will need.

'We have compared the results from our tool against the results of acknowledged experts in the various software fields, and our analyses produces results comparable to human experts,' Prof Rashid.

But the AMPLE software can do it much faster, and non-experts can use it. It is a phenomenally useful application that is already in use in other areas, analysing internet traffic to identify paedophile activity for example. It has a large future in other areas, too.

It works using a combination of information retrieval techniques like 'latent semantic analysis' and 'natural language analysis'. Latent semantic analysis reveals relationships between documents, while natural language analysis identifies nuances, such as the same word meaning different things or different words meaning the same thing.

The result is a powerful, automatic analysis of the types of features required, what Mr Rashid calls the 'asset base'. That is the first element of the 'toolsuite' created by AMPLE.

Other tools in the chain allow companies to create their modular software components, to assemble them for a specific task, and to test and validate the resulting application. Another important element is the maintenance, repair and modification of both the SPL and the software it produces.

'Software is developing all the time, with new and better techniques to do the same job, or to complete new tasks. You have to plan for upgrading and improving the product line from the beginning,' notes Mr Rashid.

'This is where traceability becomes so important. With the AMPLE toolsuite, if you change one element of the product line it will show you what other elements are affected by that change, so you can modify the other elements.'

It makes it a lot harder to break the software by adding a new element, a frequent problem in software design.

The project has completed its work and industry and academia are excited by what the team has achieved. There are a number of discussions underway to examine how the work might go forward.

One company, which worked with the project but is not part of the consortium, may incorporate elements of the initial analyses tools into its products, while the partners are discussing ways to take the work forward.

The software is already available for download on the AMPLE website, but Prof Rashid believes it will require a lot more work to make the platform a commercial package. 'Do I see the toolsuite released as a commercial product? It would take much more development. There are elements within our work that will be used... but it will take a few years for the entire suite to be up to commercial standard. Therefore, we are making some of the modelling software open source to develop it further.'

In the meantime, AMPLE demonstrated a powerful new paradigm for software development, one that could reduce costs, speed up development and lead to new small and medium-sized enterprises developing in Europe. As a bonus, they have created tools that will have impressive potential applications way beyond the software domain.

The AMPLE project received funding from the ICT strand of Sixth Framework Programme for research.



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Models make software

European researchers have developed a platform to speed up model driven engineering (MDE), the latest paradigm in computer science. The upshot is faster, cheaper software development for complex systems.

Software development is becoming so complex that a new development paradigm is required. Already standalone applications, like word processors and operating systems require hundreds or even thousands of engineers to develop.

But that degree of complexity explodes for large computer systems like enterprise applications, or airport management. The range of tasks software is required to complete and number of functions it must include, the variety of programming languages and environments it must cope with, leads to a lengthy and expensive development process.

'Complex software systems are constantly evolving, too. It also requires considerable work to modify or adapt complex systems under traditional system of software development,' explains Dr Sébastien Praud of Thales Research and Technology, technical coordinator of the 'Modelling solution for complex software systems' (Modelplex) project.

Even worse, the problem is getting bigger as computer scientists and engineers integrate larger applications and tackle more complex problems.

Enter model driven engineering. MDE is not a brand new concept — it has been around for two decades — but it is currently emerging as the most promising paradigm for complex systems. It is a technique that will help Europe, and the world, meet future software engineering challenges.

MDE, as its name suggests, creates models of the required functions tied very closely to the specific domain. Domain refers to a particular field, such as a manufacturing enterprise, or a telephone network or weather monitoring.

This has many implications. First, by tying the model to the specific domain it is intended to illustrate, engineers account for industry-specific needs. Software design starts with the domain, rather than any given set of computing functions, languages or platforms.

Second, the software design is illustrated in a way that can be understood by non-experts. It refers to real-world functions, rather than computer functions or algorithms. In traditional design, a domain expert explains to the programmer what the programmer needs to do.

But in the MDE paradigm, the domain expert, who may know nothing about computing, can review the model and point out missing functionality, or missing links between elements within the system.

Third, the model can go down to any level of detail. That means that one can look at an overview, then drill down to a specific area (order processing), and then drill down still further to specific data inputs, functions and outputs.

The entire system is mapped and then developers can create or adapt code to tie it all together. It means faster software development because the programmers have a clear idea of all the required functionality and how it relates to other elements in the system.

There is much less risk of catastrophic programming errors, because engineers can detail the links between software elements beforehand. If something is missing or has been overlooked it can be easily added to the model in a later step.

In sum, MDE models tasks for a specific domain, like telephone switching in the telecom industry, and designs the applications around that, rather than developing the software and then fitting it to the industry and its specific needs. It is faster, cheaper and can handle complex systems much more easily.

At least, that is the theory. Up to now, several problems have held MDE back. 'There are no proper tools for complex systems engineering. There are some, but there is no integrated platform for complex systems in MDE development,' explains Prof Praud.

Modelplex has developed a platform to handle the entire lifecycle of development including interoperability, substitutability and traceability. So the system can help developers ensure different platforms will work together. It can identify where code can be swapped, and it can establish links between elements of a system, so if something gets changed it will show what other elements need to be changed as well.

This means it can be updated and upgraded easily, since engineers immediately see how a change in one software element relates to changes in the rest of the system.



Modelplex dedicated an entire innovative work package to the management and monitoring of a MDE-designed system, which is important because complex systems are not often statically defined at the beginning — they evolve.

MDE is not new, and historically has been driven by aerospace, automotive, defence, telecommunications and embedded systems — areas where complexity abounds. But Modelplex provides better tools, and should make the method applicable to a host of new areas, like consumer electronics.

Take Thales, for example, a partner in the project which developed a 'system of systems' to manage air traffic control in an optimal way. It was one of the test cases Modelplex pursued to try out its ideas and prove that MDE could handle complexity.

A 'system of system' ties disparate programs and computer systems together, so that they can function as a whole. It is a vastly complex task which was aided enormously by Modelplex's huge research effort — a EUR 20.2 million budget, with EUR 11 million provided by the EU, the largest in the Sixth Framework Programme for research for this domain. It gathers a who's who of European and international software development, including Thales, SAP, IBM and Fraunhofer among many others.

Most of the work will be available for free to research, but some will remain proprietary to different partners. There will be aspects of the work commercialised, but the main aim is to create a set of tools to make MDE a viable option for industrial-strength applications. In the meantime, partners in the project hope to continue the work in a follow-on project.

But the ultimate impact of Modelplex's work will be to give Europe an expertise in MDE development, and to finally make MDE a reality.

The Modelplex project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

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New computing paradigm: ubiquitous distributed wireless computing

Harnessing many small computers to work together is a proven way to solve many types of real-world problems. Make these systems capable of learning and self-organisation, at levels from chip to network, and you have a recipe for a new computing paradigm.

European researchers have developed an innovative computing platform. At the heart of the system are many small modules, each made from chips with an inbuilt ability to learn. A self-configuring wireless network connects the modules, allowing them to operate as a coherent group.

Evolving to suit the task in hand and acting on information about their environment, such systems are described by their developers as 'bio-inspired'. They are well suited to building mathematical models of scientific problems in which complexity arises from simple building blocks, such as in brains, stock markets, and the spread of new ideas.

Researchers already use programs that can learn — neural networks — to study problems like these. Their simulations would run faster if they could hard-wire instructions into computer chips rather than load them as software, but normally this would stop the machines from learning. Chips that learn by physically reconfiguring themselves therefore offer the best of both worlds.

Large numbers of computers working in parallel to solve complex problems is not a new idea. Such networks are not very flexible, however, since the computers must be set up individually with software tailored to each task.

The European project 'Pervasive computing framework for modelling complex virtually-unbounded systems' (Perplexus) therefore draws on another hot topic in research: self-organising wireless networks which can adapt to the job in hand.

In principle, such networks could provide 'ubiquitous computing' by assembling themselves from any wireless-equipped devices within reach: computers,

smart phones, robots, even electronic toys, explains Andrés Pérez-Urbe, spokesperson for Perplexus.

In this project, the researchers confined themselves to a model network built up from one basic building block: the ubidule, a purpose-designed module about the size of a personal digital assistant (PDA). Ubidules can take information from their environments, share data wirelessly, and adapt their behaviour to the circumstances. In a large network, for instance, some ubidules may evolve to specialise in a particular task, which other ubidules then delegate to them.

Key to every ubidule is a processor chip, the ubichip, which can learn and evolve. This idea began with an earlier European project which developed a processor based on a large number of identical sub-units or cells. Depending on the current task, each cell can vary its function by changing its internal wiring; at a higher level, links between cells can also be made or broken. Until now, such flexibility has only been available from chips that are externally programmed. The ubichip, in contrast, works out the necessary wiring for itself.

The researchers say ubidules can model both grid-based problems in the physical sciences, and the harder-to-formulate challenges of biological systems and social sciences. They have used ubidules to develop biologically-plausible neural network models of the brain, for instance, and to study how ideas spread between people.

Problems which can be visualised as grids or networks are often studied with the help of autonomous programs known as agents, which collect and exchange information



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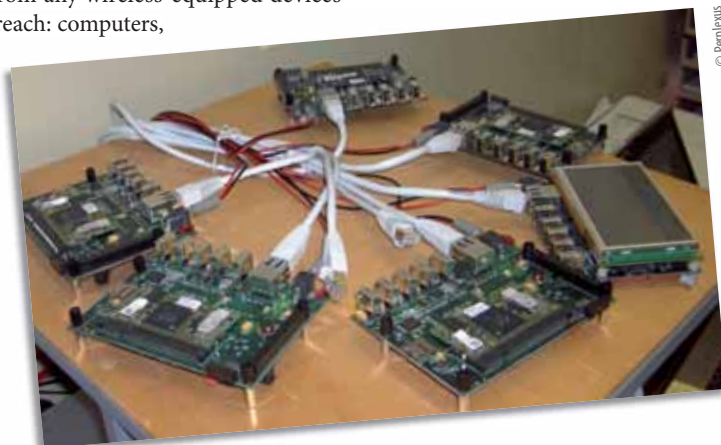
from different parts of the network. At the moment this exchange is often quite basic, with agents simply passing on all the information that comes their way. Mr Pérez-Urbe explains that a network of ubidules could give each agent its own neural network. By interpreting data and being more selective about what they pass on, these intelligent agents could yield better models.

Another branch of the project involved a fleet of small but sophisticated all-terrain robots fitted with ubichips. The researchers developed a new strategy in the field known as collective robotics, whose premise is that groups of robots which communicate with one another are more effective than the same robots acting individually.

In this case, the researchers looked at how foraging robots locate an important place such as a collection point for items they have picked up. Each robot displays a coloured beacon and carries a video camera which can see other robots' beacons. Robots change the colour of their beacons to signal that they have successfully found the target, and nearby robots copy this behaviour.

The result is a gradient of beacon colours which guides other robots towards the target, rather as in an unfamiliar shopping mall where you might locate a particular store by following a trail of people carrying distinctive plastic bags. According to Mr Pérez-Urbe, this technique is promising for situations where navigation by fixed coordinates or GPS is impossible.

Reflecting its forward-looking nature, Perplexus is dominated by academic institutions in France, Poland, Spain and Switzerland. The project received funding from the ICT strand ('FET proactive') of the Sixth Framework Programme for research.



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Europe's nanowires, all grown up

Breakthrough European nanowire research could lead to faster, smaller, low-power chips. It's all in the nurturing.

Nanowires are a promising new technology that could meet rapidly rising performance requirements for integrated circuit design over the next ten years. They are tiny wires just tens of nanometres in diameter and micrometers in length.

They could mean smaller, faster and lower power electronics, and lead to entirely novel architectures such as 3D microchips — a vertical stack of circuitry that can massively increase the size of circuits for the same footprint.

Nanowires are so narrow they are often called 'one-dimensional' structures because the width of the wire constrains the sideways movement of electrons as they pass through the wire. Also, the cylindrical geometry allows the most efficient electrostatic gating technology.

Unsurprisingly at this scale, nanowires demonstrate many characteristics that offer the potential for novel circuits and architectures, and physicists are very excited. The Japanese pioneered the field with the USA taking up the work, and with a few European teams entering soon after.

But the Europeans are on their way. Recent work at the 'Nanowire-based one-dimensional electronics' (NODE) project led to world-class technology and 40 patents. 'Silicon technology becomes very challenging when you get down to 10-15nm,' explains Lars Samuelson, director of the Nanometer Structure Consortium at Lund University and coordinator of the project.

'One of the problems of the [current] top-down approach is that it introduces harsh environments and you end up with devices that may be dominated by defects.'

NODE's nanowires are 'grown' from the bottom up, like crystals, into vertical structures. 'We call it "guided self-assembly", and it is a "bottom-up" process that can result in fewer defects,' Mr Samuelson says.

Vertical nanowires can consist of different materials, by simply altering the depositing material, so the wire takes on layers with different characteristics. 'There are many potential opportunities for developing new technologies,' he says. 'This verti-

cal arrangement may be the route to 3D circuit design as well as to realise monolithic on-chip optoelectronics.'

NODE focused on combining silicon with indium arsenide (Si:InAs) and silicon with silicon germanium (Si:SiGe), two very promising materials. 'Indium arsenide is inherently very fast and, as such, it was of particular interest to our work,' remarks Mr Samuelson.

The project looked at every link in the nanowire production chain, from growth, processing on an industrial scale, to characterisation and integration. 'And one of the big challenges of the project was the integration of our work with current silicon processing technology, so there was a big effort on processing,' Mr Samuelson stresses.

For this, characterisation studies were important to examine the different materials used and the effects induced by the nanowire structure. NODE also examined the characteristics of potential devices, such as field effect transistors (FET). Finally, the team looked at integrating these devices into circuits.

It is a huge body of work and led to some real breakthroughs. 'One of the breakthroughs was the... perfect deposition of high-K dielectrics coating the nanowires and serving as dielectric in the wrap-gate transistors,' reveals Mr Samuelson. 'We developed a very good technique for this.'

High-K dielectrics overcome some of the limits of silicon dioxide at very small scales and are a promising strategy for further miniaturisation of integrated circuits.

'As part of this research, we have also encountered problems and possible roadblocks [to further] development, such as quite severe problems in growing Si nanowires using gold catalysts,' adds Mr Samuelson.

'This technology is not ready for industrial applications, and whether it will be three, six or nine years before it appears industrially, I cannot say,' he warns. 'But we established the state of the art, we have the best results.'

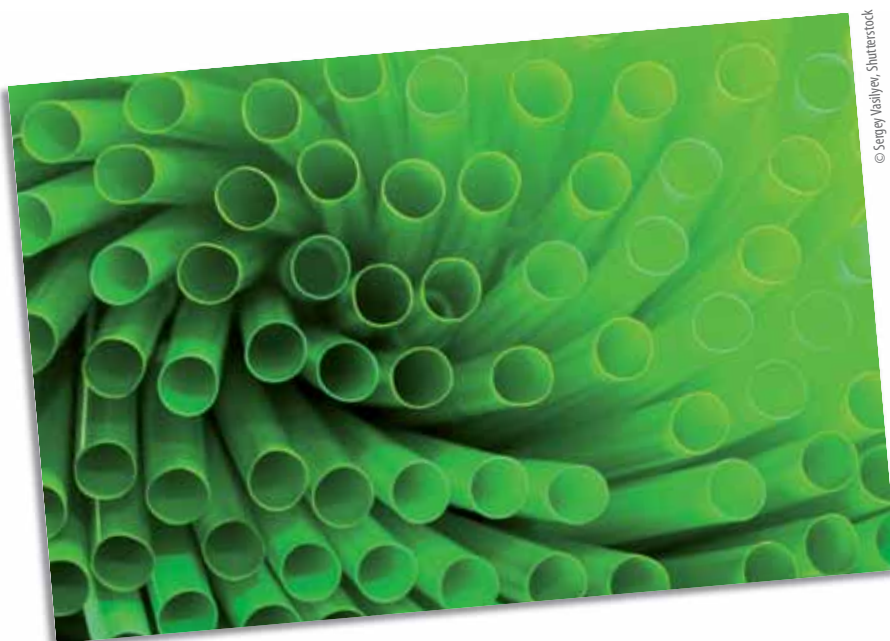
The project has announced Europe's entry into an exciting new field of nanotechnology and developed a core expertise on the continent. Over 100 scientific papers should emerge from the work when it concludes.

The development of European expertise could not come at a better time. Industrial players like IBM, Samsung and some of the leading Singapore labs began developing planar, or horizontal, nanowire technology shortly after NODE began their efforts. The technology is coming of age.

The NODE project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

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Trusted computing goes beyond state of the art

European researchers are taking trusted computing beyond the state of the art with a paradigm-shifting solution.

Trusted computing (TC) is a hot topic in computer science. Major software and hardware providers are planning to include TC components in the next generation of computers, and the US army and the US department of defence reportedly require trusted platform modules on all their computers.

Trusted computing is a system comprising hardware and software modules that ensures that the software running on a computer has not been altered or maliciously modified after its initial installation, thus ensuring compliance with the original intended functionality. It is a way of enhancing security, preventing viruses and other malicious code, or malware, and protecting intellectual property.

For example, a TC system can verify that a malicious user has not altered the program of the music player on his computer in such a way as to ignore or bypass the checks on the permissions and restrictions of the songs being played.

Current systems work but are heavily dependent on hardware which limits their usefulness. A big problem facing computer science now is how to ensure a trusted computing environment on a remote, untrusted, machine.

This is an important problem. Trusted computing can reduce or even eliminate the risk of viruses and malware, and it can enormously enhance computer security — all major gains for consumers.

The module system can also be employed as a useful tool for digital rights management (DRM). It goes far beyond current validation methods — which often only authenticate the software during installation, leaving both the code and the computer vulnerable to later modification.

But lessons from the past show that hardware-dependent security systems are dogged by problems. They can fail to entrust valid software, or can fail to communicate with other elements in the system. This happened, notoriously, with some systems using new DRM techniques for high-definition TV.

Difficulties can arise, too, when components are updated. A far more robust solution would provide real-time 'entrusting' on remote, untrusted machines. It could enhance security and provide a universal solution to the trusted computing challenge.

The solution may not be far off, thanks to the work of the European 'Remote entrusting by run-time software authentication' (Re-trust) project. Re-trust sought to provide remote, real-time entrusting on an untrusted machine via the network.

'In many cases, computers are connected to the network at all times, and this trend is increasing,' explains Yoram Ofek, coordinator of Re-trust.

'Initially, we started out with the assumption that nothing can be trusted, but on reflection, we realised that many network entities are trusted, like Google, Yahoo, Ebay or Microsoft,' he explains. 'So then we looked at how we could create trustworthy entities on the network that could then ensure software was authenticated on untrustworthy machines.'

Re-trust provides a novel methodology for both software-only and hardware-assisted remote entrusting (RE).

Whereas hardware-assisted entrusting requires a special chip either on the computer's motherboard or inserted into a USB drive, Re-trust uses logic components on an untrusted machine to enable a remote entrusting component to authenticate — via the network — the untrusted machine's operation during runtime. This means it ensures that the software is running properly and that the code integrity is maintained, thus almost completely guaranteeing security.

It is a big idea. 'All applications and solutions running over a network, such as the internet, can benefit from the Re-trust approach. Re-trust will have a major impact on all commercial applications and solutions where security or trust is a concern, independently of whether they are based on a client-server or a peer-to-peer paradigm,' Prof Ofek explains.

This will become even more vital as more and more services move online. Already, music is increasingly distributed online and TV is shifting in that direction. Software and data are mature online markets that could also benefit from the Re-trust approach.

Currently, digital rights holders stand opposed to peer-to-peer networks, mainly because of their association with piracy. But peer-to-peer still offers probably the most efficient distribution method for large files. The Re-trust solutions could entrust peer-to-peer networks so they become a powerful new distribution channel.

The team developed a large number of novel solutions to persistent problems. Code mobility and reconfigurable computing for software protection use mobile hardware agents, essentially a 'dongle', that implement monitoring techniques for securely producing and delivering code integrity attestations for an application.

Orthogonal replacement, on the other hand, is a novel client code replacement strategy. The client code is periodically replaced by new code. That code, when combined with the code running on the server, delivers seamless functionality to the user and so remains invisible to the latter, while in fact the code is mutating in real time, thus preventing any malicious manipulation and frustrating any attempts to reverse engineer the original application.

Voice over internet protocol (VOIP), too, came under the scrutiny of Re-trust. Project partner Gemalto provides a USB device that contains a smartcard. By taking advantage of the USB device, this integrity role is delegated to the smartcard. With this design, a monitor sends application properties to the local control service located on the smartcard which is able to check for the code integrity.

These are just a few of the results, and the project has already had a big impact. Some of the work, like Gemalto's smartcard, has direct applications, with other work destined for future technologies or products.

Finally, the researchers will continue with some elements of their study. It all means that, in the very near future, our trust will reside in the network.

The Re-trust project received funding from FET open activities of the EU's Sixth Framework Programme for research.

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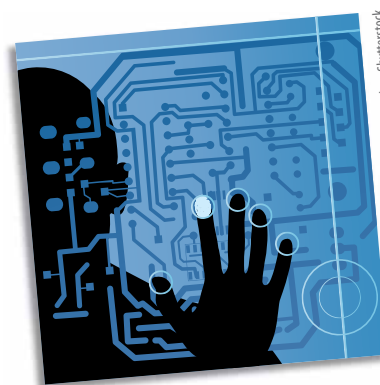
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What is the identity of identity?

The nature of our identity in the information society is much more complex than before, and European researchers at one network of excellence are working hard to keep pace.



What is identity? In the digital age, this has become one of the big questions. The multiplication of online personas, the numerous and increasing contexts where identity plays a role, and the perennial problem of establishing reliable, secure identity in cyberspace make this one of the bigger challenges that the information society faces.

The 'Future of identity in the information society' (FIDIS) is a network of excellence (NoE) set up to prepare Europe for the many emerging identity issues.

'As usual with research, particularly in a multidisciplinary project like FIDIS, we started out by defining our terms and looking at the nature of identity,' explains André Deuker of the Goethe University Frankfurt and a researcher at the FIDIS project. 'What is the identity of identity?'

'We concluded that it is not one, single concept, but rather it is a host of pieces of information about an individual. So we came up with the concept of partial identities, where you might exchange your credit card information, for example, but wouldn't reveal your eye colour, or social security number.'

So in the FIDIS network of excellence, identity are all those pieces of information that define a particular individual, from their DNA to how they like to take their coffee. Depending on the context, people will decide to reveal some information, but not all.

Such general statements provide the essential framework to approach a sprawling issue like identity, and are particularly useful for networks like FIDIS.

NoEs exist to create world-class expertise in a given scientific field by linking all the industry and academic players that contribute to a particular domain. Scientists, engineers, theoreticians, psychologists, legal experts and other social sciences can meet and get to know one another around a series of important problems in a particular field.

In this way, researchers in different areas, but working on the same problem, can learn about issues facing other disciplines. They make contacts and can help each other. The upshot is a much stronger research resource for Europe, and much greater standing across the world.

The future of identity in the information society is one of those big problems that can benefit enormously from this type of concerted effort. It is a complex and diverse prob-

lem, touching every area of life. It requires co-operation between many scientific, social and economic fields.

The FIDIS work programme was as ambitious as its topic, and included research on basic questions to leading-edge technologies like photo response non-uniformity (PRNU).

Photo response non-uniformity is an unwieldy mouthful that hides a really cool technology that can identify the camera responsible for any particular image. It works by looking at the information underlying a specific image.

Each digital camera sensor has a unique signature, like a fingerprint, and PRNU can spot that signature and use it to prove a particular camera took an image. The technology has obvious applications in forensics — identifying, for example, a camera used to take a particular photograph in a blackmail or hostage case.

But it could also be potentially used for security, by confirming that a camera registered to a passport office took a particular image, or confirming that the right authority issued a specific security badge.

Other initiatives within the FIDIS network include high-tech identification, special radio frequency identity (RFID) tags. In one experiment a researcher was implanted with an RFID tag and sensors were able to track his movements within the research facility.

FIDIS also tackled more mundane — and arguably more important issues — like identity management systems (IMS). The European landscape is littered with a variety of diverse regulatory systems — national identity cards are mandatory in Germany and France, for example, but do not exist in this way in the UK or Ireland.

Similarly, there are many different systems for managing ID, whether it is passport or social security databases. FIDIS looked at the range of IMS platforms available, and created a database of them. It is hoped that this work will lead to greater interoperability between systems over time.

Another focus was put on mobile identities because GSM subscriber identity modules (SIMs) are one of the first globally interoperable identity infrastructures. And the related information gets richer and richer, including not only location information but more and more context information. This

leads to opportunities, for example marketing, but also to new challenges with regard to privacy,' notes Kai Rannenber, professor at Goethe University Frankfurt and coordinator of the FIDIS project.

'Moreover, mobile communication infrastructures lead the way to ambient intelligence and the related challenges.'

The FIDIS team also developed some compelling scenarios about the future of identity. It put together a very detailed 'story' about a couple living in a world of ambient intelligence, where the couple's preferences in music, lighting and temperature are all noted with a hotel booking, for example.

More urgent examples abound in this lengthy and detailed scenarios document, where the wife of the couple goes into labour while travelling. Here, all the relevant medical information is transferred in a way that only the attending physician can access the data.

And the scenarios deal with realistic situations too, where incompatibility between computer systems means information cannot transfer easily. The document, which received contributions from many of the major partners, touches on virtually every aspect of life and offers a realistic basis for discussion.

The work of FIDIS led to the publication of dozens of articles, the foundation of a new journal, and has set the scene for the development of identity technologies over the next decade.

Finally, insights and knowledge gained over the five-year FIDIS NoE have been federated in the book entitled 'The future of identity in the information society: challenges and opportunities', published by Springer in April 2009.

It means that, at least in Europe, the future of identity in Europe should not lead to identity crises.

The FIDIS project received funding from the ICT strand of the EU's Sixth Framework Programme for research.

Promoted through the ICT Results service.

<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91163>

Rapid laser lights the way for lab-on-chip

Just as electronics went from huge vacuum tubes to tiny microchips, the life sciences are also pursuing miniaturisation. A European research project has now shown how to build optical sensors into glass chips, paving the way for better portable biochemical laboratories and on-the-spot medical diagnostics.

People have been working on the 'lab-on-chip' concept for more than a decade. The idea relies on microfluidics, where tiny volumes of sample liquids move along microscopic channels cut into a variety of substances including silicon, glass and plastic.

True, this technology has progressed phenomenally: it is now possible to separate samples at the molecular level on a chip which is no larger than a postage stamp. But the lab-on-chip hype usually fails to address a 'big' problem: you usually still need large-scale equipment to detect and identify the molecules flowing inside the microfluidic chips. The fluidics is certainly at the micro-scale, but the optical molecular detection is still firmly rooted in the macro world of life-size laboratories.

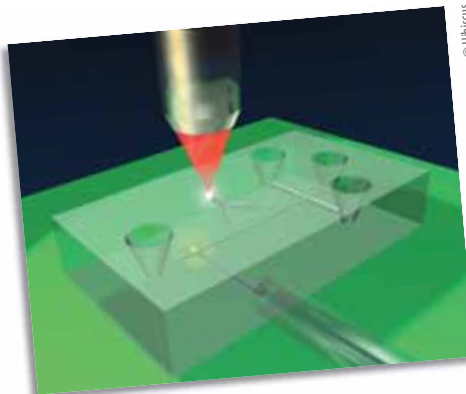
Except now an EU-funded project has been able to 'inscribe' features into microfluidic chips, making integrated optical detection a possibility for the first time.

The consortium 'Hybrid Integrated biophotonic sensors created by ultra-fast laser systems' (Hibiscus), involving academic and industrial partners, used a technique called femtosecond laser micromachining. The femtosecond laser emits extremely short light 'flashes' — each lasting no more than a few millionths of a billionth of a second. This pulsation makes the laser beam extremely intense, and can alter materials in unusual ways. By focusing the beam you can use the laser like a microscopic tool or pen and 'draw' physical features in three dimensions into a thin wafer of glass.

This micromachining technique has already been used to cut intricate components, like gears and motors into silicon. The Hibiscus team was able to inscribe tracks, called waveguides, into labs-on-chips. The waveguides channel light through the chip, across the microfluidic channels and back out of the chip where it is detected. They could also use the laser to produce the microfluidic channels themselves.

It is now possible to shine a light source (usually a laser) into the sample fluid and detect its absorption or other optical activity directly in the chip, rather than having to take a sample from the chip and analyse it with laboratory equipment.

'This is the first time that waveguides have been put into a lab-on-chip using the rela-



tively straightforward femtosecond laser micromachining process,' explains Giulio Cerullo who coordinated the project. 'It now means that, at last, a lab-on-chip can finally be shrunk fully, with optical detection and analysis taking place within the chip.'

One exciting demonstration by the project shows that it is possible even to detect small changes in the refractive index of a sample flowing in a micro-channel using a three dimensional detector called an optical interferometer. In this case the waveguides are laid out so that one passes through a microfluidic channel while the other one passes just above it. The liquid flowing in the channel induces a tiny change in the path length of the light between the two waveguides, which is picked up by the interferometer. This makes it possible to detect very small changes in the sample composition.

The project has made prototype labs-on-chips with integrated waveguides for several biological applications, including a DNA-fragment separation and detection assay (which could be used to detect specific disease markers in patient samples) and a chemical micro-reactor for protein synthesis.

Mr Cerullo's dream is that the lab-on-chip could help doctors perform virtually immediate medical diagnoses in their own practices. They could take a sample from a patient and immediately run it through a small device, which would be able to detect marker molecules — protein markers for a disease or the telltale DNA sequence of a genetic disorder.

'Once you make detection part of the lab-on-chip, you have miniaturisation of an entire analytical laboratory,' he remarks. 'It brings diagnosis to the point of care. A patient goes home without that awful sense

of uncertainty hanging over them until they get their test results back. Or they can receive urgent medical treatment — a day or two's advance on treatment can mean life or death for some cancer patients.'

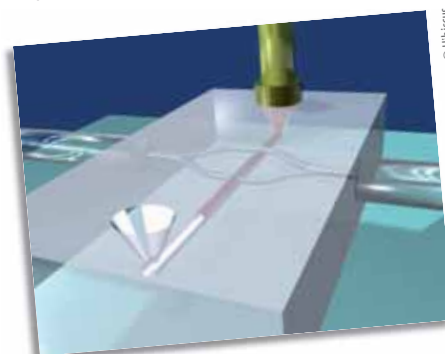
The Hibiscus consortium includes three commercial small and medium-sized enterprises as partners which are all exploiting the results of the project. 'High Q Laser' in Austria is already selling the femtosecond laser that it developed for the project. Lionix, based in the Netherlands, manufactures microfluidic chips and is now looking to make labs-on-chips that incorporate the waveguides. The Dutch firm 'Zebra bioscience' is developing kits for point-of-care diagnostics.

Mr Cerullo reckons that an integrated lab-on-chip would not be prohibitively expensive for medical professionals. He estimates that the initial investment for a lab-on-chip manufacturer to set up the micromachining technology for the waveguides would be around EUR 200 000. Total investment to manufacture fully integrated labs-on-chips may reach several million Euros. But this outlay is relatively low once it is spread across the millions of disposable chips that could be sold to medical practices and hospitals around the globe.

The integrated optical detection also makes feasible the idea of using microfluidics as an efficient and more eco-friendly production method for pharmaceutical products.

'Our project is the last piece in the lab-on-chip puzzle,' concludes the project coordinator. 'It will open the door to many exciting applications, especially much faster, on-the-spot medical diagnosis.'

Hibiscus received funding from the ICT strand of the EU's Sixth Framework Programme for research.



Promoted through the ICT Results service.
<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91178>

See also page 40 'Towards the ultimate in semiconductor miniaturisation'

A new approach to network visualisation

Significant progress has been made by informatics experts in Germany concerning the graphical representation of data collected from complex networks such as the internet.

The sheer size of the internet makes it very difficult to represent graphically, even small parts of it. Yet being able to 'visualise' the net has never been more important as more and more people join the online population and attempt to navigate the unique landscape of the world wide web. It could also be exploited to help analyse network traffic data.

Researchers with the Universitaet Karlsruhe in Germany took up this challenge in the framework of the 'Co-evolution and self-organisation in dynamical networks' (COSIN) project which was sponsored by the EU's future and emerging technologies programme (FET open).

The approach involved experimenting with new graph-drawing algorithms that allow the identification of specific network fingerprints, such as the hierarchical structure of computer generated and real world networks. Even though a fair amount of software was available to enable the visualisation of network data, the state of the art at the time seemed too heuristic to be satisfactory to support network analysis.

In finding a suitable tool for the 'visualisation' of very large networks (millions or even billions of nodes), the team at Universität Karlsruhe in Germany collaborated closely with other members of the COSIN research consortium. With the use of graph theory and statistical methods, they were successful in dealing with a multi-layer description of large networks that seems to reproduce most of their properties. Furthermore, once decomposed into a number of sub-systems, non-trivial and readable drawings can be established that showed all nodes and edges.

In addition, existing methods of graph drawing were modified and combined in order to address the needs of specific types of networks, such as autonomous system (AS) networks. The Universitaet Karlsruhe scientists hope to continue their work extending algorithm theory to network visualisation.

Funded under the FP5 programme Information Society Technologies.
(FET open).

Collaboration sought: further research or development support;
information exchange/training.
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Measuring quality for better network service

In order to achieve service continuity across different network technologies and multiple paths, mechanisms for controlling performance were examined for their reliability and usability within a communications service.

Communication networks are a part of everyday life making both work and personal communication possible. The primary concern for most end users is that communication services operate at their optimum level with regard to their security and dependability.

Under these conditions, the 'IPv6 quality of service measurement' (6QM) project examined the global management architecture for quality of service (QOS) measurement so that both users and service providers can have a better understanding of what is entailed.

Quality of service measurement is essentially a collective effort of service performance mechanisms for controlling the functioning, reliability and usability of a telecommunications service. Additionally it enables the different relationships which exist between QOS components. These are namely user-oriented components such as resolution of problems and ease of service as

well as network-oriented components such as performance aspects.

In order to begin to define the management architecture supporting QOS, essential groundwork was completed. Included was the examination of passive and active measurement architectures in order to improve them as well as to possibly link the two. Passive measurement architecture involves QOS measurement results that are computed without the introduction of any alteration to the network traffic being monitored. On the other hand, results of computations for active measurement architecture may involve modifications to the network traffic.

Yet another major task was the analysis of intra- and inter-domain measurements. Intra-domain measures are those which take place within the boundaries of an enterprise whereas those for an inter-domain occur across enterprise boundaries.

All measurement systems contain common properties and components which are in collaboration providing a user with QOS measurements. Since these are essential for fulfilling the function of measuring traffic flow through any domain, having a better understanding of their requirements will prove useful for service providers, network operators and end users alike.

Funded under the FP5 programme Information Society Technologies

Collaboration sought: information exchange/training.
<http://cordis.europa.eu/marketplace> > search > offers > 5348



Moving beyond virtual reality

Pioneering efforts in image processing are opening up new horizons that could allow users to explore foreign lands without ever leaving the comfort of their own home.

The ability to experience a specific place without actually being there has long intrigued researchers. New techniques, such as image-based rendering (IBR), offer the promise of moving beyond conventional virtual reality to a more realistic three-dimensional environment that can be experienced in real time.

The European Commission supported a number of important research projects in this field, including the 'Being there without going' (Benogo) project. Computer vision specialists with the Hebrew University of Jerusalem in Israel developed a new, powerful IBR algorithm during the project.

A series of photographs shot from different positions within the scene are required as input. A model of the scene is then constructed in which every point can be defined by a ray connecting two slits, known as the X-slits projection. This information can subsequently be exploited to generate views from any number of paths through the scene.

The main advantage of the new algorithm is its speed, which allows it to deliver high quality images of photographic quality in real time. This feature makes the new technology suitable for a wide range of application areas. The Hebrew University of Jerusalem and its Benogo partners are planning further research accordingly.



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Funded under the FPS programme Information Society Technologies
Collaboration sought: further research or development support.
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Watch this space!

Keep an eye out for the next issue of *research*eu focus* showcasing the research, innovation and technologies behind Europe's explorations of the final frontier... space. Let's embrace it!

Giving shape to public opinion at museums and galleries

The power of video for assessing the human response to new forms of artistic expression was successfully demonstrated during the European SHAPE project.

Museums and galleries are experimenting with cutting edge exhibitions that blur the line between the real world and the virtual world. They are populated with hybrid artefacts that possess both physical and digital attributes. It is essential to gauge the public's reaction to these so-called 'living exhibitions'.

Rather than rely upon traditional methods of eliciting public opinion, such as questionnaires or interviews, scientists at King's College London came up with a new approach. Their pioneering research was supported by the 'Information society tech-

nologies' programme in the framework of the 'Situating hybrid assemblies in public environments' (SHAPE) project.

The technique involved an intricate analysis of video footage of museum visitors observing and discussing the exhibits. Body language and spoken language were examined both separately and in relation to one another according to the tenets of ethnomethodology. This provided insight into key aspects of social interaction in the context of the exhibits.



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A crucial advantage of this method was that it captured both the individual and group response in real-time as the exhibit was being experienced. The researchers with King's College London have moved to copyright this technique, which has been described in a number of papers and presented at several conferences.

Funded under the FPS programme Information Society Technologies
Collaboration sought: further research or development support.
<http://cordis.europa.eu/marketplace> > search > offers > 5238

Cloud attacks killer

Cloud technology is helping to treat victims of cancer, Europe's second largest killer, thanks to the work of European researchers and industry.

Cancer is Europe's second largest killer and one of the most difficult diseases to treat. There are dozens of therapeutic protocols designed to respond to the vast diversity of cases that confront doctors.

Radiotherapy has proven a particularly effective treatment. Here a linear accelerator, or Linacs in the jargon, attacks the cancer directly by delivering radiation from several directions. But treatment is complex. The direction, size and duration of dosages are all tailored to each case, and must be recalculated every time via simulation.

It is a phenomenally complicated computation, requiring lengthy processing time, so much so that it can mean delays and this has the knock-on impact of lowering the number of patients who can be treated by each Linacs machine.

Faster diagnoses would help, but the required computing power is expensive, dramatically increasing the Linacs installation and operation costs. It is a critical bottleneck.

But not for long. A cloud computing solution for radiotherapy developed by the 'Business experiments in grid' (Beingrid) project uses a computer grid. This type of infrastructure can share out resources like processors, storage, networking and software, wherever they are and on whatever platform.

Grids can deliver on-demand hardware and software, and because they are combined into a super system, they offer much more power at lower cost.

The individual elements of the system are hidden in the cloud, invisible to the user. The new 'Radiotherapygrid' delivers two services: treatment plan verification and search. The search function is optimised to provide alternative treatment plans based on the patient scan, treatment prescriptions and other constraints.

Both services can run in the background. The doctor simply enters the details in a browser window, and is alerted by email when the results are ready. Security and service level agreements (SLAs) are a particular focus of the 'Radiotherapygrid'.

Grids excel at delivering these kinds of benefits, because they ensure that resources are used to the maximum of their capacity. Security can be guaranteed because the computers on the grid behave like a single supercomputer.

The upshot is that doctors can call on enormous computing resources without paying the full costs. It offers better performance, delivering faster results, and only when the service is required. Hospitals do not have to pay when the machines are idle.

'The system can also be extended and adapted, to use new algorithms when new techniques and protocols are developed,' reveals Andrés Gómez Tato, a Beingrid business experiment manager from CESGA, one of project consortium.

The Beingrid partners in the radiotherapy application are now looking to exploit the service commercially, and they believe the market is very promising. Initially, the 'Radiotherapygrid' will be primarily marketed as a 'software-as-a-service' platform at these institutions, but ultimately it may also come with hardware.

Moreover, the 'Radiotherapygrid' could be applied to other treatment modalities, like the image guided radiotherapy (IGRT), hadrontherapy or brachytherapy.

Cloud services, however, are not just for healthcare. The power, security, reliability and collaborative advantages of grids could offer cloud services to any industry sector. In fact, Beingrid developed 25 business experiments in various industrial sectors to demonstrate to small and medium-sized enterprises (SMEs) the power of cloud computing.

The 'Radiotherapygrid' has demonstrated the power, security and reliability of the cloud for the health sector, while another demonstration, the 'TravelCRMgrid' service, demonstrates the power of the cloud's collaboration and information sharing potential in tourism.

The independent travel agencies (ITA) lining high streets across the continent are under threat from new market forces like the internet. Typically, these ITAs are very small and consist of a few branches. Usually, they band with other ITAs to form a confederate travel agency group (TAG).

These TAGs could compete better if they could capture more qualitative data about their customers and share that data between them. It would enable them to provide a better, more tailored service, and market to a larger number of customers.

This describes the sort of benefits expected from advanced content resource management (CRM) and business intelligence (BI) services. They are usually pricey, and

deploying them on a motley collection of diverse platforms would raise the cost further. Beingrid's 'TravelCRMgrid' business experiment sought to push the issues of cost and complexity into the cloud.

'TravelCRMgrid' is an e-commerce travel solution that will offer these tools, capable of generating valuable data within the travel sector, based on the real day-to-day transactions of TAGs.

It means more intelligent business decisions about what to buy from wholesalers or how to create effective and focused marketing campaigns. By focusing on more profitable strategies, ITAs will be able to offer high-value personalised travel services to their customers at reasonable prices and effectively compete in an arena currently the preserve of large companies that can afford CRM and BI in-house solutions and have enough data to make their use worthwhile.

These are just two compelling examples developed by Beingrid to show how cloud computing services can help SMEs. The intention is to provide best practices, case studies and tools, and to develop cloud implementation expertise in Europe.

SMEs are the lifeblood of European competitiveness but so far they have been slow to benefit from the power of cloud computing. The Beingrid project, however, proves that clouds are more than a just a cancer killer, they are a killer app.

The Beingrid project received funding from ICT strand of the Sixth Framework Programme for research.

Promoted through the ICT Results service.

<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91193>



Anaerobic solutions for agro-industrial waste treatment

Valuable insight was gained during the Agroiwatch project by testing several different anaerobic reactors with similar types of food processing waste.

Proper management of waste produced by agro-industry presents a serious environmental challenge. A project sponsored by the European Commission sought to facilitate knowledge transfer between Europe and the Balkans on this topic. Three years of research culminated in specific recommendations regarding the application of anaerobic techniques.

Since the chemical composition of the wastewater and solid waste can vary significantly, it was not possible to rely solely upon theory to propose a viable solution. Consequently, a series of laboratory experiments were carried out by engineers at the Hydro Engineering Institute Sarajevo (HEIS) located in Bosnia and Herzegovina, under the Agroiwatch⁽¹⁾ project.

A comparison of the output of a continuous-flow stirred-tank reactor (CSTR), an inclined plug-flow reactor and a two-stage reactor incorporating acidogenic and methanogenic vessels was made. Waste from a potato processing plant was fed to the reactors at varied loading rates in controlled environmental conditions. The biogas generated by the reactors was sampled periodically and analysed.

The team at HEIS concluded that the inclined plug-flow reactor not only turned in a solid performance, but was also the easiest of the three reactors to design and operate. An organic loading rate (OLR) in the order of five kilograms of chemical oxygen demand (COD) per cubic metre per day was possible, after which stability became a limiting factor.

Finally, the data collected was also used to calibrate the anaerobic digestion model⁽¹⁾ (ADM 1) to a high level of accuracy. For this reason, ADM 1 was recommended for scaling the reactor up to the size necessary for use in actual food processing plants.

⁽¹⁾ 'Cost-effective technologies for wastewater treatment and waste biodegradation in agro-industries with reclamation of resources.'

Funded under the FP5 programme INCO 2
(Confirming the international role of Community research).
Collaboration sought: further research or development support.
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Pilot reactor for treating wastewater with ozone

The production and processing of agricultural products can place major demands on resources of fresh, clean water. European researchers have developed a pilot reactor which treated wastewater with ozone, enabling the water to be reused.

Agro-industrial activities such as sugar production, brewing and the processing of fruits and vegetables can have a serious environmental impact. These operations require large quantities of clean water which are then discharged as polluted wastewater containing organic matter and nutrients. The wastewater can pose a threat to aquatic ecosystems and result in a significant reduction in water quality.

A number of cost-effective techniques have been developed to reclaim wastewater by removing pollutants and producing valuable biogas. The water can then be subjected to biological and chemical treatment, enabling it to meet quality standards before being reused. The solid waste can also be treated and used as a soil conditioner or fertiliser, thereby, reducing the need for synthetic fertilisers. One form of treatment for wastewater is to dissolve ozone into it, using an injector for the gas and agitating the liquid with a booster pump. However, this technique is energy intensive.

The European-funded Agroiwatch⁽¹⁾ project developed a treatment system comprising a stirred bubble column pilot reactor. The system used a ceramic diffuser to create very small bubbles, requiring only a small amount of energy. The reactor was also fitted with a bypass for the gas, allowing ozone levels to be measured both at the inlet to the reactor and at the outlet point for the gas. The level of ozone entering the liquid was controlled through the length of time it was exposed to the gas.

Researchers applied 100ml of a salt solution tracer to the reactor inlet during its continuous operation. The residence time distribution of the salt solution was determined by measuring by the difference in conductivity which is directly proportional to the tracer's concentration.

The reactor was operated using a range of flow rates for demineralised water and air. Studies of the residence time distribution within the reactor showed the significant influence of the stirrer and volumetric flow

rate of the fluid. The effect of the gas flow rate was not found to be significant, while varying the active volume of the reactor allowed it to be adapted to a range of different needs.

⁽¹⁾ 'Cost-effective technologies for wastewater treatment and waste biodegradation in agro-industries with reclamation of resources.'

Funded under the FP5 programme INCO 2
(Confirming the international role of Community research).
Collaboration sought: further research or development support.
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See also page 20 '**Resolving biomass gasification wastewater issues**'



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Turning potato processing waste into valuable biogas

Engineers from Bosnia and Herzegovina learned how to maximise the output of a reactor capable of digesting agro-industrial waste products.

The processing of fruits and vegetables generates substantial quantities of wastewater as well as other types of waste. The organisations involved in the Agroiwatch⁽¹⁾ project saw an opportunity to derive value from this waste stream by generating biogas.

Initial tests in the laboratory were followed by the assembly of a full-scale pilot plant based on an inclined plug flow reactor with anaerobic treatment. Scientists with the Hydro Engineering Institute of the University of Sarajevo (HEIS) located in Bosnia and Herzegovina were responsible for evaluating the performance of the reactor.

Waste from a potato processing plant was used as a feed source. A number of different parameters were observed and recorded continuously, including reactor temperature, gas quantity and quality, volatile fatty acids, pH and alkalinity. Additional samples were collected at several different locations inside the reactor chamber.

The primary discovery made by the team at HEIS was that the reactor was very sensitive to loading. In fact, they found it was possible to totally disrupt steady-state operation by overloading the reactor. Complications also arose when volatile fatty acids were allowed to build up to the point of causing the pH to drop.

In response to these findings, the HEIS researchers recommended that pH be closely monitored as well as alkalinity in case the slurry is well buffered. With respect to the loading regime, smaller batch volumes should be preferred. Additional work is also needed to further reduce the system's hydraulic retention time.

⁽¹⁾ 'Cost-effective technologies for wastewater treatment and waste biodegradation in agro-industries with reclamation of resources.'



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Funded under the FP5 programme INCO 2
(Confirming the international role of Community research).
Collaboration sought: further research or development support.
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Identifying the best sorption model for polymerisation

The relative accuracy of several theoretical concepts that describe the phenomenon of sorption was evaluated during a four-year European research project entitled Polyprop.

The project 'Polyolefins: improved property control and reactor operability' (Poly-prop) secured substantial funding from the European Commission to investigate and optimise the polymerisation of olefins in reactors. Sorption, which includes both absorption and adsorption, is an integral part of this process. A significant portion of the research was therefore dedicated to an extensive investigation of sorption models.

Following a review of all relevant literature, a series of experiments were carried out to compare actual data against values predicted by theory. For example, the Sanchez-Lacombe equation of state (S-L EOS) was used to calculate the amount of swelling following the sorption of ethylene by polyethylene. The

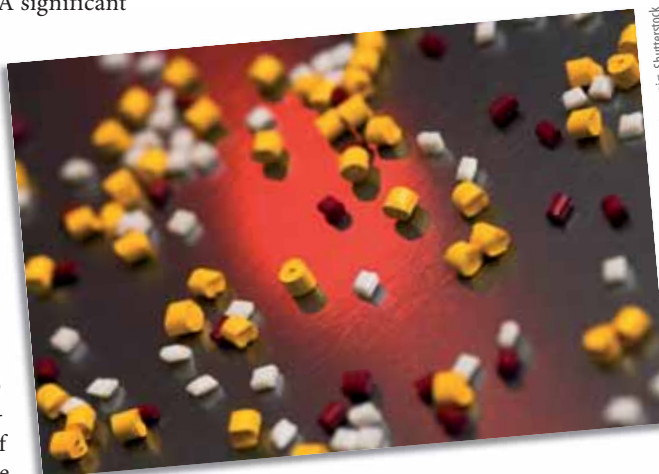
results were highly encouraging. Part of the laboratory work also involved assessing the impact of varying the catalyst and other process parameters.

Another aspect examined by the Poly-prop participants was the effect of particle

diameter and temperature on the sorption of propylene by polypropylene. In this case, better agreement was achieved by applying a temperature-dependent constant based on Henry's law rather than with the S-L EOS. Furthermore, it was shown that the results could be extended to the liquid phase by applying Flory-Huggins theory.

Finally, valuable insight into the differences between gas and liquid phase kinetics in the presence of a Ziegler-Natta catalyst was obtained. Specifically, it was demonstrated that catalyst efficiency did not vary between the two phases when other experimental parameters were held constant. These findings were subsequently exploited during the design of the Polyprop reactor.

Funded under the FP5 programme Growth
(Competitive and sustainable growth).
Collaboration sought: further research or development support; information exchange/training.
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European innovation in flame retardant textiles

Innovation in the manufacture of flame retardant fabrics will help Europe comply with increasingly stringent standards while remaining a global leader in the field of fire safety.

The trend to phase out halogen-based flame retardants derives from the environmental and safety issues associated with their use. The European Commission made funding available to stimulate research to develop viable alternatives. The 'New fire retardant textiles' (Nerefite) project involved 17 organisations from five different EU Member States.

The potential of intumescent compounds, which expand when exposed to heat, was investigated in a laboratory setting. The resulting char not only severely limits heat transfer but also helps deprive the fire of combustible material. The work was overseen by scientists with the Centre for the Engineering of Plastic Materials (CDCMP) in Italy.

The experiments sought to maximise the impact of the catalysts used during the formation of the intumescent from a charring agent and a blowing agent. In addition to ammonium polyphosphates (APPs), the team at CDCMP found that ammonium trihydrate (ATH) greatly enhanced thermal resistance.

The Nerefite researchers also examined in detail the behaviour of ATH as well as that of APPs and binder resin when exposed to heat. The knowledge of how these components interact with one another during the process of thermal degradation will be exploited to further optimise the intumescent formulations.

Funded under the FP5 programme Growth
(Competitive and sustainable growth).
Collaboration sought: further research or development support.
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Towards the ultimate in semiconductor miniaturisation

A European research team including experts in nanotechnology, optoelectronics and quantum physics has advanced the state of the art in the emission, manipulation and detection of single photons on semiconductor platforms.

The team achieved several breakthroughs, including a new record in quantum dot spacing, and the technologies they have pioneered bring a wide range of single-photon and quantum applications a significant step closer.

The ultimate in semiconductor miniaturisation is to use single photons and electrons to carry and manipulate information in the form of quantum bits or qubits. Researchers from some of Europe's leading universities, public research institutes and industry-based labs have combined forces under the aegis of the EU-funded QPHOTON⁽¹⁾ project to create new semiconductor-based devices that reliably and efficiently emit, detect and allow the manipulation of single photons.

'Current single-photon sources are not very useful in terms of efficiency and quality,' says Johann Reithmaier, the coordinator of QPHOTON. 'We set out to address this — to strongly improve the efficiency of producing single photons without any background of other photons.'

The suite of devices QPHOTON developed may enable multiple applications including low power, highly integrated photonic circuits; practical quantum cryptography and telepor-

tation; and, eventually, new routes to realise ultra-powerful quantum computers.

One of the consortium's key goals was to improve the assembly and control of semiconductor-based quantum dots.

Quantum dots are nano-sized structures that can confine electrons in three dimensions. By manipulating the size, shape and composition of the dots, researchers can gain very fine control over their electronic and optical properties, for example triggering them electronically to emit single photons.

Until now, most quantum dots have been grown through self-assembly, which leaves the dots scattered randomly in a solution or across a surface.

The QPHOTON researchers devised a way to grow quantum dots exactly where they wanted them by first etching minute holes in a semiconductor substrate. Still, getting the dots to have the precise properties the team wanted turned out to be a major challenge. 'The primary layer was optically dead,' says Mr Reithmaier, 'so we needed additional tricks to overcome this.'

The researchers developed a series of cleaning and deposition steps that allowed them to grow high-functioning dots where they wanted them, and, in the process, achieved a new record in terms of the density of quantum-dot spacing.

More importantly, however, the researchers were able to link those quantum



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dots to other nano-structures in order to enhance and exploit their properties. They found ways to combine the precisely spaced dots with minute vertical pillars and horizontally aligned microcavities, both of which emitted single photons far more efficiently and reliably than the previous state of the art.

The pillars emit light perpendicularly to the surface of the semiconductor. They can be used as robust sources of single photons, which could for example be coupled to optical fibres for long-distance transmission.

The horizontal microcavities are extremely promising as key parts of highly integrated circuits that would use photons rather than electrons to process information. The researchers also developed an innovative vertical photonic crystal assembly to extract single photons from these circuits with more than 80 % efficiency.

Another major innovation was the development of 'photonic wires' — precisely assembled linear structures that advanced the state of the art by a factor of two in terms of the efficiency of transmitting single photons. 'Pushing the coupling efficiency to about 85 % is a major breakthrough for single photon emitters,' says Mr Reithmaier.

This advance is particularly promising for the secure distribution of quantum keys, which enable ultra-secure data transmission. Only by sending one photon at a time can information be transmitted without any risk of it being compromised.

For the past ten years, researchers worldwide have been avidly exploring the field of slow light. A variety of nano-structures have been found to have the ability to slow light dramatically. Engineers hope to use this effect to create memories, buffers and switches for high-powered, energy-efficient optical computers.

The QPHOTON researchers chalked up another first by demonstrating a strong slow light effect in a semiconductor quantum dot material.

Most previous research with slow light used media — gas for example — that would not be useful in actual computers. So showing that quantum dot arrays can slow light in a semiconductor is potentially very important for optical computing.

Reithmaier cautions that the ability of slow light to carry enough information to support optical data processing has not yet been demonstrated, and may turn out not to be possible. Still, QPHOTON's findings

will be utilised in a new EU-funded project aimed at further exploring the potentials of slow light.

Mr Reithmaier believes that the steps they've taken to control the emission, manipulation, and reception of single photons bring practical quantum computers significantly closer.

'The major challenge is to move quantum information from one location to another, and a major approach is single photons,' he says. 'For that you need full control of the photon, and that's where we really pushed the technology.'

The QPHOTON project received funding from the FET open strand of the EU's Sixth Framework Programme for research.

(¹) 'High-Q semiconductor nanostructures for single photon emission, detection and manipulation.'

Promoted through the ICT Results service.
<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91174>

See also page 34 'Rapid laser lights the way for lab-on-chip'

Final design parameters for new particle decelerator

Researchers under the umbrella of the high-profile Hitrap project successfully developed a particle decelerator for use in the large accelerator facilities of Europe.

Several well-known particle physics research facilities are located in Europe. Funding from the 'Human potential' programme was set aside to further develop this infrastructure. For instance, the goal of the project 'An ion trap facility for experiments with highly-charged heavy ions' (Hitrap) was to establish a laboratory dedicated to trapping highly charged heavy ions.

The research consortium included nine partners from seven different EU Member States and was led by GSI Helmholtzzentrum für Schwerionenforschung GmbH in Germany. The design of several important components of the Hitrap decelerator constituted an important project deliverable.

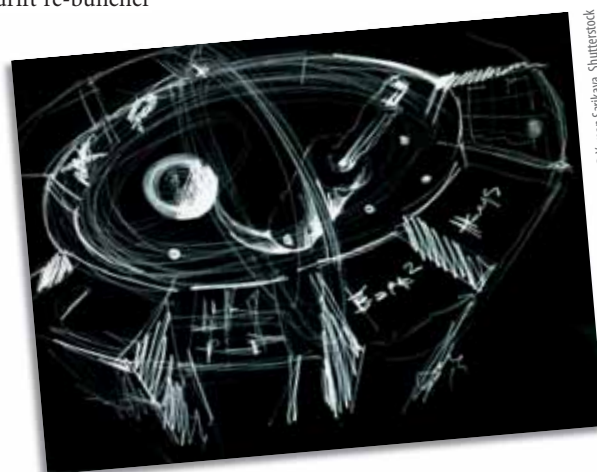
Beam dynamics calculations were performed from the experimental storage ring (ESR) through the cooler trap, including the

re-buncher, the 'Interdigital H-mode' (IH) structure and the radio-frequency quadrupole (RFQ). Matching the phase spread from ESR to IH-structure was enhanced by incorporating a double drift re-buncher (DDB) while a low energy de-buncher helped improve injection efficiency into the Hitrap cooler trap.

The result was a system capable of decelerating 70 % of the particles drawn from storage. Magnetic quadrupole lens data, three-dimensional computer assisted design (CAD) drawings and other essential design parameters were

assembled in order to facilitate the ensuing tender procedures. The completion of the final design of a new particle decelerator is certain to contribute to extending Europe's legacy in particle physics.

Funded under the FP5 programme 'Human potential' (Improving human research potential & the socio-economic knowledge base).
Collaboration sought: further research or development support; information exchange/training.
<http://cordis.europa.eu/marketplace> > search > offers > 5342



New techniques ensure accuracy in modern chip production

As computer chips rapidly continue to evolve, new technologies must be developed to closely monitor the fabrication process and guard against faults at a sub-microscopic level.

More than 40 years ago Intel co-founder Gordon Moore predicted the capacity of computer chips would double every 2 years for a 10-year period. He was wrong about the time, but right about the rest. Despite frequent reports and predictions of its demise, Moore's law is still going strong today.

The development of a host of new technologies enabling ever-increasing miniaturisation has resulted in a new generation of smaller, smarter chips coming to market approximately every two years.

The current generation of chips measures just 45 nanometres (nm). In 1990, state-of-the-art chips measured 800nm, and in 2000 this was down to 180nm. However, the next generation of chips which manufacturers are working on now will measure just 32nm with 22nm expected two years later and 16nm two years after that.

Alongside the techniques which allow an increasing number of transistors to be placed on an integrated circuit, a new set of techniques also has to be developed to allow the measuring of fault tolerance on a tiny scale.

And the jump from 45nm to 32nm is such that entirely new techniques are required, because the existing way of checking for faults on chips may not be accurate enough at this new level.

To overcome this problem, an EU-funded SOCOT⁽¹⁾ project was set up bringing together a vendor of metrology — measuring — tools, a software developer with experience in metrology, a chip manufacturer and an R & D centre.

Project coordinator Daniel Kandel says measuring for faults has always been a key part of the chip-making process but the EU project was necessary 'because there was a significant risk that, at 32nm, no existing technology could measure the alignment between layers with sufficient precision and accuracy'. He points out a 32nm wide line is only the width of 59 silicon atoms — silicon being the main material for making the wafers the chips are embedded in.

One of the most important measurements is the alignment between the numerous layers which make up semiconductors. The

maximum error the manufacturer is prepared to accept is known as the overlay control budget.

With the 45nm generation of chips, the budget allowed for an error is 10nm. This came down from 12nm with the previous generation with similar gradual reduction from earlier generations. But the evolution from 45nm to 32nm technology has seen the need for a much sharper jump in alignment requirements, from 10nm to 3nm.

'The measurement accuracy is typically one-tenth of the error that can be tolerated, so in this case the metrology has to be accurate to 0.3nm or 3 angstroms,' says Mr Kandel.

This sudden reduction between the current and next generation has meant the technology used for measuring this and previous generations of chips may no longer be effective. The problem is that current technology involves looking at images of patterns on adjoining layers with a very powerful microscope. The images show what, if any, misalignment there is between the two layers.

But with the alignment requirements now being equivalent to the width of a small number of atoms, even the most powerful microscope is not able to achieve this level of accuracy and precision and so imaging overlay technology may no longer be viable.

The researchers realised a whole new approach was needed and decided to experiment with scatterometry, a new technique which is already in use for other types of measurement in chip-manufacturing facilities.

'With scatterometry you do not need an image, you simply scatter light,' explains Mr Kandel. 'Using the measuring tool we have developed, you illuminate the wafer with light of a variety of wavelengths and then measure the scattered light. We have developed sophisticated software programs or algorithms which allow us to calculate the level of misalignment from the light signatures,' he says.

Scatterometry has other advantages over techniques that employ microscopes, because images are sensitive to the optical quality of the lenses which can produce optical aberrations. Imaging technology is

also sensitive to the focus of a microscope which can easily be set too high or low. Scatterometry is insensitive to errors in focus or the optical quality of the tool being used.

The project's researchers initially set up simulations to confirm their projections could be met, and then they built a prototype tool to achieve optimal architecture and performance. This was demonstrated in an R & D environment and a misalignment measure of 3 angstroms accuracy was achieved.

'We showed you could perform this type of measurement, and control the process using the results obtained and that is where the project ended,' says Mr Kandel.

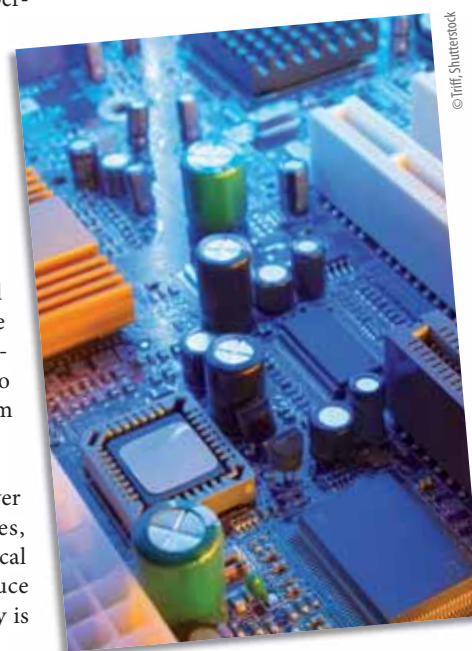
However, the work done in SOCOT lives on and the next generation of measuring tools will be based on the technologies researched in the project. 'Chip-makers will be able to buy a commercial product to use in their facilities when they switch to next-generation manufacturing,' he says.

Initially, he expects the technology to be used only in the most critical layers where tolerances are very tight. However, they will last through the next few generations of chips and more layers will be measured in this way at the 22nm and 16nm levels.

SOCOT was funded under the ICT strand of the EU's Sixth Framework Programme for research.

⁽¹⁾ 'Scatterometry overlay control technology in the integrated circuit industry for the 32nm technology node and beyond.'

Promoted through the ICT Results service.
<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=91167>



Minimising downtime by decentralising control

When complex, computerised control systems encounter a malfunction in any part of the process they control, the whole operation often grinds to a halt while the problem is diagnosed and fixed. Software developed by European researchers overcomes that problem by decentralisation.

Power stations, oil refineries, factories and other types of industrial plant will, when some more development work has been done, be much better able to work around localised faults, thanks to European research.

Road vehicles, ships and aircraft could also benefit from the results and prototypes developed by the EU-funded 'Networked control systems tolerant to faults' (NECST) project.

With a partner mix comprising four universities, two software developers and an oil company, the project set out to develop and test a set of algorithms — simple software programmes — for use in networked control systems (NECS).

These systems may operate at a number of different levels in complex industrial facilities. The project made them fault tolerant by making individual components of the overall system as autonomous as possible. This means, once a fault is diagnosed or predicted, and the problem is being pre-empted or fixed, the rest of the network can carry on operating as normal.

Says project coordinator Eric Rondeau: 'The systems can be seen as a distributed network of nodes operating under highly decentralised control, but unified in accomplishing complex system-wide goals.'

In human terms, this is somewhat analogous to a team sport, such as rugby where there are specialist players performing different functions, but all also working together as a team to fulfil the same objective — winning. If one team member is injured or sent off, the team still continues and compensates for the loss.

For example, in a petroleum-oil refinery (which was the actual practical testing ground for a prototype NECST algorithm) the overall objective is to produce high-quality products. To do this, there are a large number of different processes, all of them falling under a networked control system. If a fault develops in one of the processes, then rather than the whole system shutting down for it to be fixed, NECST isolates the fault and allows the rest of the system to continue functioning.

To carry the rugby analogy further, if the captain is the one injured that still does not mean the team stops playing as other players step in and fill the leadership gap. In a NECST system there are individual processors, each controlling a specific function. If the network goes down, and system control is cut off, they are still able to operate autonomously and make sure their part of the system continues working towards the common goal.

The partners set out to develop both a software platform and a toolkit of software modules or algorithms. These run on the platform and provide the monitoring, diagnostic and remedial-action functions for a fault-tolerant network — that is a network which can work around a fault rather than being forced to close down.

A key part of the project was to ensure the software developed could be integrated with, and embedded in, users' current and future control systems. Once in place, the project objectives required it to be able to generate information on network behaviour and to communicate with, and advise, human operators.

These objectives were achieved during benchmark tests in a laboratory environment and a real-time test was successfully conducted in the oil refinery operated by the end-user partner.

Now the two software companies, which were partners in the test, are working on developing commercial applications, and the research work has been found to have wider implications.

French company Predict has integrated the NECST software into its 'Knowledge advanced services for e-maintenance (KASEM)' platform. This is designed for nuclear and conventional power plants, oil refineries and shipping.



— Polycr. Shutterstock

By creating a fault-tolerant control network, KASEM allows operations to continue when part of the system is down for whatever reason. This guaranteed continuity of service means regular maintenance work can be undertaken without the need for plant closure, which is of particular value to power plants.

Slovakian partner SAE-Automation has produced its own proprietary software based on the NECST research. The first commercial installation of this was set to take place in a heating, ventilation and air conditioning (HVAC) system in Malaysia.

'Although we were looking at the implications for industrial facilities, the software can be used in any situation where there is a networked control system, a modern car for example,' says Mr Rondeau.

The NECST system has seen widespread commercial use, its viability has been proven and there are important implications for enhanced performance in a range of fields.

NECST was funded under the ICT strand of the EU's Sixth Framework Programme for research.

Promoted through the ICT Results service.

<http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&ID=90183>

Infrared thermography finds niche in plastics

Researchers at the Spanish Toy Technological Institute (AIJU) have found that infrared thermography is a technique that can be used in the plastics industry, specifically for process optimisation and quality improvement.

The research is part of the EU-funded Custom-fit⁽¹⁾ project. Supported under the Sixth Framework Programme (FP6), financing for Custom-fit stands at EUR 9.25 million.

Concerning the thermoplastic injection process, the researchers say extensive information about the transformation process can be gathered when thermographic images are taken of injected pieces that are either in the mould or have been extracted, or even in the mould surface itself. The AIJU team assessed the injection process on a toy hobby-horse mould in their study.

The German-born British astronomer, Sir Frederick William Herschel, discovered infrared radiation in 1800. He observed that the heat going through coloured filters he used to look at the sun was dependant on the colour of the filter. Sir Herschel directed the light through a crystal prism to produce a spectrum (the rainbow) and then measured the colours' temperature. Based on his observations, the temperature was higher on the red side. This side's light was invisible to the human eye. 'Caloric rays' was the term given to this radiation, and was later coined 'infrared radiation'.

Around 80 years later, American scientist Samuel Pierpont Langley invented the world's first ever bolometer (infrared radiation detector). The bolometer could detect radiation by the rise in temperature generated by a heat-absorbing body. During the 1980s, researchers developed micro-bolometers, which are now being used in thermographic cameras.

According to the AIJU researchers, all objects that have a temperature higher than 'absolute zero' (-273.15°C) produce waves in the infrared band. The higher an object's temperature, the more energy generated in a lower wavelength. They noted that infrared radiation, visible light and ultraviolet light are forms of energy found in the electromagnetic spectrum that vary in wavelength.

The human eye can only see a limited range of wavelengths. However, thermographic cameras can detect infrared energy that is not visible to the human eye. These innovative cameras can register normal temperatures ranging from -20°C to 500°C, but they can also register from -40°C at the bottom end up to 2,000°C at the top end.

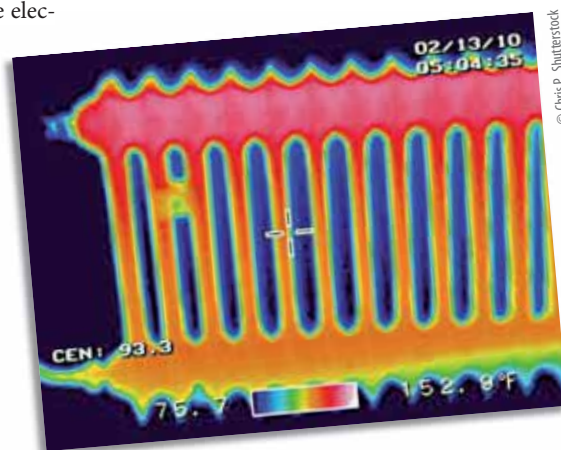
According to the researchers, thermographic cameras transform the infrared energy into an image with a colour map that indicates the temperature of the object at each point. The end result is a versatile camera equipped with an infinite range of applications in various sectors.

The AIJU researchers are currently working with industry on various research and development projects in the plastics sector.

⁽¹⁾ 'A knowledge-based manufacturing system, established by integrating rapid manufacturing, information society technologies and material science to improve the quality of life of European citizens through custom fit products.'

Funded under the FP6 programmes IST and NMP (Information Society Technologies and Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices).

<http://cordis.europa.eu/news> > search > 31128



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Stabilising thermal barrier coatings with ytterbium

An in-depth study of thermal barrier coatings that was funded in part by the European Commission turned up some surprising results.

Thermal barrier coatings (TBCs) safeguard metallic components from the effects of high temperature in aeronautics and other demanding fields. TBCs reduce the threat of thermal fatigue and can therefore significantly extend the expected lifetime of the parts they protect.

An extensive investigation of TBCs was carried out in the context of a European-funded project 'Science of high performance multifunctional high temperature coatings' (Hipercoat). Material scientists with the University of California, Santa Barbara in the United States evaluated the stability of zirconia-based TBCs doped with several different metals, including scandium (Sc), yttrium (Y) and ytterbium (Yb).

The behaviour of the TBCs varied

considerably depending on the choice of doping material. In the case of Y, the advantage of non-transformability, which is crucial for applications involving cyclic thermal loading, was lost. This was contrary to the latest published research. In fact, the best results were observed for Yb.

Thermodynamic modelling was subsequently employed to determine which of the doping materials delivered the greatest toughness, another key TBC parameter. Yet again, Yb proved to be several times stronger than the other alternatives. Finally, experiments with co-doping indicated that durability could be improved when Y was paired with lighter elements.

These findings will be exploited by the organisations participating in Hipercoat in the development of next generation TBCs.

Funded under the FP5 programme Growth (Competitive and sustainable growth).

Collaboration sought: information exchange/training.
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Scientists sequence wild grass species

*An international research team has successfully sequenced the wild grass **Brachypodium distachyon**, a grass species related to major cereal grains like wheat, barley and oats.*

Published in the journal *Nature*, the study's findings are part of the EU-funded project 'Arabidopsis growth network integrating omics technologies' (Agronomics), which received EUR 12 million under the 'Life sciences, genomics and biotechnology for health' thematic area of the EU's Sixth Framework Programme (FP6).

Some grass species play a pivotal role in meeting our food supply needs. We have also seen a surge in the domestication of new grass crops for feedstock production and sustainable energy. Experts say, however, that failure to understand how genes work and a lack of knowledge about their large and complex genomes lead to obstacles that restrict crop improvement.

By sequencing *B. distachyon*, the researchers shed light on how grass genomes develop and expand. The study was led by the John Innes Centre in the UK, Oregon State University in the US, and the US Department of Energy, the Joint Genome Institute and the US Department of Agriculture.

The researchers said the results of their study indicate how *B. distachyon* can be used to

navigate the closely related yet far larger and more complex genomes of wheat and barley.

'Our analysis of the *Brachypodium* genome is a key resource for securing sustainable supplies of food, feed and fuel from established crops such as wheat, barley and forage grasses and for the development of crops for bioenergy and renewable resource production,' explains Professor Michael Bevan of the John Innes Centre.

'It is already being widely used by crop scientists to identify genes in wheat and barley, and it is defining new approaches to large-scale genome analysis of these crops, because of the high degree of conserved gene structure and organisation we identified.'

The team says what is also unique about *B. distachyon* is that it develops quickly but also grows compactly, thus making it a perfect candidate for laboratory studies.

'Scientists can now use genetic resources we are developing in *Brachypodium* to determine the functions of genes involved in grass crop productivity,' says Dr Philippe Vain from the Department of Crop Genetics at the John Innes Centre, who is also



heading a programme that targets providing researchers with resources to identify gene functions.

'This has the potential to accelerate research in sustainable food production and in new sources of energy,' he adds.

Also contributing to this study were scientists from Belgium, China, Denmark, France, Germany, Poland, South Korea, Switzerland and Turkey.

The Flanders Interuniversity Institute for Biotechnology in Belgium is coordinating the Agronomics project that kicked off in 2006 and is scheduled to end in 2011. This integrated project brings together 14 partner laboratories from six European countries including France, Germany, Spain, Switzerland and the UK.

Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 15173

EU project reinforces construction sectors

The construction sector has benefited immensely from advances in materials over the years. Curtain wall facades, in particular, have benefited from light, easy-to-assemble materials, but the use of aluminium and steel is still widespread. More sustainable alternatives are needed.

The project 'Polymeric nanocomposite profiles for curtain walls' (Facomp), backed by the EU with EUR 954 000 under the Seventh Framework Programme (FP7), is determined to define a novel system and a nanomaterial to replace steel and aluminium for structural profiles.

Coordinated by Cidemco-Tecnalia Technological Centre in Spain, the Facomp partners say they target the development of curtain wall sections based on polymeric nanocomposites instead of aluminium or steel. Curtain walls are favoured by people because they are easy to construct and are light. Their popularity is also due to the wide range of materials and textures that can be used for their final surface finish, according to the partners.

One of the benefits of using aluminium frames in curtain walls is that they are

usually infilled with glass which provides a great deal of natural light. The problem, however, is how to best control sunlight as it can cause thermal and visual discomfort.

The Facomp partners believe the new system under development should have mechanical properties that are either equal to or even better than what are in use today. They should also be more resistant to harsh weather, be lighter and offer people better thermal and acoustic components. The use of polymeric nanocomposites reinforced with inorganic fibres and nanoparticles (nanoclay) will also lead to changes in how the rest of the curtain wall's components, such as silicones glass, and joints, are designed.

The Facomp team has already completed 50 % of the project and has prepared the potential design of the first prototype.

The partners believe their project's achievements will include the development of composite sections, whose best characteristics are mechanical behaviour, enhanced thermal insulation, and better resilience to bad weather. According to them, the mechanical behaviour of these innovative composite sections is either equal to or better than aluminium sections.

The team is also actively optimising the techniques and formulation for composite processing, as well as evaluating various processing techniques. Ultimately, the target is to create a real-scale curtain wall prototype by using the new nanocomposite sections. Not only will the nanotechnology used in this project help the team clinch better resistance and rigidity in the final material, but it will result in improved performances against fire, they say. Facomp brings together seven research and industry partners from Spain, Italy, Sweden and the UK.

Promoted through the Research Information Centre.
<http://ec.europa.eu/research/infocentre> > search > 15473

The following upcoming events were selected from the event diary of the Directorate-General for Research and from the CORDIS event calendar. For further information on past and upcoming events, please visit:

<http://ec.europa.eu/research/events>

<http://cordis.europa.eu/events>

Nanoparticles: characterisation and environmental risk assessment

This one-week post-graduate workshop on nanoparticles will be held in Aveiro, Portugal from 17 to 23 May 2010.

The environmental risk assessment of nanoparticles is still not fully understood. This workshop will aim to explore the environmental risks of nanoparticles, their chemistry and geochemistry, including aspects related to synthesis and environmental detection.

Scientists, PhD and MSc students with a background in biology, natural and environmental sciences, chemistry, environmental engineering or related fields are encouraged to attend, as too delegates from consulting companies and institutions responsible for environmental management.

For further information, please visit:
<http://www.cesam.ua.pt/index.php?tabela=NanoObj&language=eng>

Heinz Maier-Leibnitz prizes 2010

This year's Heinz Maier-Leibnitz prizes will honour six outstanding young researchers in Bonn, Germany on 20 May 2010.

It is Germany's most prestigious award for young scientists. Over 100 were nominated but only 6 will receive the award. Each winner will receive Euro 16,000 to help support the prizewinners in continuing their scientific work.

For further information, please visit:
http://www.dfg.de/gefoerderte_projekte/wissenschaftliche_preise/leibnitz-preis/index.html

Workshop on controlled environment agriculture in space

The fourth international workshop on agrospace, 'Controlled environment agriculture from Earth to space and back', will be held in Sperlonga, Italy on 20 and 21 May 2010.

This event will combine those involved in the controlled environment (CE) community along with the interdisciplinary controlled environment agriculture (CEA) community. The aim of the workshop is to enhance and enrich research in food production systems that are restrained by both space and the resource-limited biosphere. Knowledge obtained by food production in controlled environments in space could help improve resource allocation and reduce the environmental impact of agriculture on Earth.

Presentations on the successes and challenges of space life support and Earth food production applications are also scheduled. The workshop also intends to establish a mandate that will encourage the use of the latest developments in science and technology with the production of food.

For further information, please visit:
<http://www.agrospaceconference.com>

International symposium: stem cells in biology and disease

A three-day international symposium on stems cells in biology and disease will be held in Lisbon, Portugal from 26 to 28 May 2010.

The symposium will address the latest issues on stem cells. The programme includes six scientific sessions, each with a keynote speaker. The sessions cover the following topics:

- cancer stem cells;
- fate switching and induced pluripotency;
- neural stem cells;
- neurodegenerative disease modelling & prospects for neural repair;
- technological advances in manipulating pluripotent stem cells;
- control of stem cell state and pluripotency.

The symposium is organised by Estools, which is a collective of European researchers investigating the fundamental biology of human embryonic and induced pluripotent stem cells. Their four-year project spans 10 countries and has combined the expertise of 21 academic and commercial research teams.

For further information, please visit:
<http://www.estools.eu/Lisbon>

Heart failure congress

The heart failure congress is organised by the Heart Failure Association (HFA) of the European Society of Cardiology (ESC) and will be held in Berlin, Germany from 29 May to 1 June 2010.

This four-day conference is addressed to all professionals interested in the broad spectrum of problems relating to heart failure.

The conference is encouraging audience participation and will provide opportunities for interactive educational sessions. A forum on the latest breakthroughs in clinical science is also scheduled.

For further information, please visit:
<http://www.escardio.org/congresses/HF2010/Pages/welcome.aspx>

Small satellites systems and services — '4S symposium 2010'

This biannual event on small satellites will be held in Madeira, Portugal from 31 May to 4 June, 2010.

Small satellites provide crucial information in diverse areas, from weather forecasting in remote areas to emergency situation awareness and atmospheric research, among others. New synergies between society and coordinated investments will have to be explored to take full advantage of the potential of small satellites.

The event will address the expanding role of small satellites in our knowledge-based society. The five-day programme will include discussions on academic projects, knowledge development and other related topics.

For further information, please visit:
<http://www.congrex.nl/10a03/>

'Green week 2010'

The annual 'Green week' event will be held in Brussels, Belgium from 1 to 4 June 2010.

This year, the largest annual conference on European environment policy turns the spotlight on biodiversity. The conference will address the state of biodiversity in Europe and the world, the benefits it brings, present-day pressures it is facing, and possible solutions to the current rates of loss.

For further information, please visit:
<http://www.greenweek2010.eu>

Quantum engineering of states and devices: theory and experiments

A six-day conference on quantum engineering in Europe will be held in Obergurgl, Austria from 5 to 10 June 2010.

Bringing together leading scientists and young researchers from a wide range of physics communities, the conference aims to provide a forum that will stimulate discussions to facilitate the achievement of scientific excellence throughout Europe.

Participants will be able to present their latest findings and recent developments in complementary areas of physics relevant for the quantum engineering of entangled states and quantum devices.

The conference will include lectures by invited high-level speakers, short talks by young and early stage researchers, poster sessions and discussion, and a panel that will discuss future developments.

For further information, please visit:
<http://www.esf.org/activities/esf-conferences/details/2010/confdetail312.html>

'Persuasive 2010'

The 'Fifth international conference on persuasive technology' will be held in Copenhagen, Denmark from 7 to 10 June 2010.

Technologies influence human behaviour and even the way we think. Persuasive technology is used to describe a new field of research that focuses on how these interactive technologies impact our lives in ways we are not fully aware of. The field reaches across several branches of science, including epistemology, rhetoric, social psychology, communication and information science.

The four-day conference will feature new insights, research and practice into the development and use of technology and its influences. Conference participants include those interested in networking, presenting, discussing and reflecting on central themes associated with persuasive design and technology.

For further information, please visit:
<http://www.persuasive2010.org/>

International polar year Oslo science conference

Lillestrøm, Norway will host this one-week conference on polar research from 8 to 12 June 2010.

Promoted as the largest polar research gathering on record, the conference will include over 2,600 presentations representing a broad range of international interdisciplinary fields of science. The conference revolves around the following six themes:

- links between polar regions and global systems;
- past, present and future changes in polar regions;
- polar ecosystems and biodiversity;
- human dimensions of change: health, society and resources;
- new frontiers, data practices and directions in polar research;
- polar science education, outreach and communication.

The conference programme will also showcase research and findings through a 'Polar cinema' experience, a 'Polar festival' and an exhibition space called PolarEXP.

For further information, please visit:
<http://www.ipy-osc.no/>

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