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RESULTS SUPPLEMENT

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Better, smarter transport

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EDITORIAL

Better, smarter transport… what else?

Safety and the environment are driving myriad changes in the way Europe — and indeed the whole world — views mobility. The European Commission has invested years and billions of euros in research and technological developments which are spearheading future transport solutions, from more efficient train networks and air traffic control, to 'intelligent cars' which talk to one another and the road infrastructure.

For example, the vehicle-to-vehicle (V2V) communication technology which allows a group of vehicles to exchange data automatically with one another and with traffic control centres could pave the way to more efficient and safer European road networks. The technology could be useful to drivers, traffic police, emergency services and companies with a fleet of vehicles to manage. The systems could help drivers keep up to date with weather or road conditions immediately ahead, allowing them to choose alternate routes, easing congestion and cutting down on accidents.

In this issue of research*eu results supplement *we bring you European efforts to develop* ***'Better, smarter transport'*** *solutions both for today and for tomorrow. We feature an interview with David McMillan, the director-general of Eurocontrol, Europe's main agency for air traffic management issues.*

Our biology and medicine section leads with research by the Estools project, an EU-funded study shedding light on DNA changes in human embryonic stem cells. We also probe the mysteries of the brain and unveil an early warning system for cancer.

The top story in our energy and transport section introduces a vision for a new, cooperative traffic system based on advanced communication hardware and software, a kind of automotive internet. We also look at some software algorithms that are the very model of railway efficiency.

The environment theme kicks off with new research and statistical tools that literally join the dots of air pollution, giving a better picture of potential hot spots.

In our IT and telecommunications section, readers get a glimpse of how scientists plan to cope with the complex networks of embedded electronics and sensors finding their way into a growing range of applications, including V2V communication.

Our lead story in the industrial technologies theme showcases two important breakthroughs by European researchers which have brought an emerging nano-scale fabrication technology out of the lab and into the real world. The technique promises lower-cost production of nano-devices at higher resolutions.

As usual, the events section offers a selection of upcoming conferences and gatherings in the field of research and technology.

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

The editorial team

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Thank you to David McMillan for his contribution to the 'special' dossier in this issue

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EU-funded study sheds light on DNA changes in human embryonic stem cells

Scientists in Europe have discovered that the prolonged culture of human embryonic stem cells (hESCs) can trigger changes resulting in chromosomal abnormalities.

Published in the journal *Nature Biotechnology*, the findings are an outcome of the 'Platforms for biomedical discovery with human ES cells' (Estools) project, which received EUR 12 million under the 'Life sciences, genomics and biotechnology for health' thematic area of the EU's Sixth Framework Programme (FP6). Estools set out to develop the skills, tools and techniques needed for medical, pharmaceutical and bio-industrial applications of human ES and induced pluripotent stem (IPS) cell research.

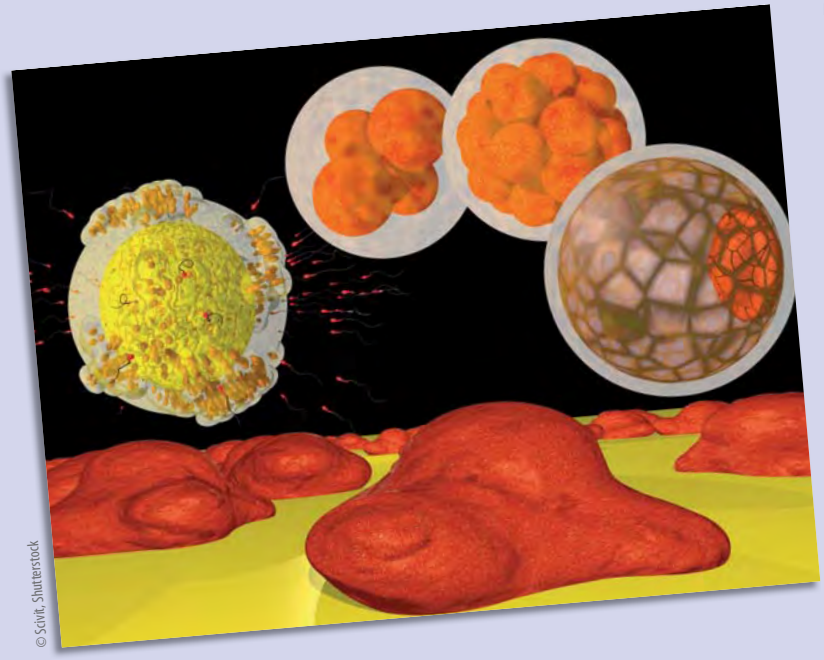
Scientists seeking to determine how to best prevent harmful changes in cultured hESCs will benefit from the results of this latest study, as the findings will help them to secure more reliable applications of stem cell-based regenerative treatments. The research team said the findings will also support further examination of the so-called culture adaptation process, in which hESCs in culture mimic the accumulation of genetic changes typical of malignant transformation; this has the potential to offer clues to some genetic mechanisms responsible for cancer development.

'Prolonged culture of hESCs can lead to adaptation and the acquisition of chromosomal abnormalities, underscoring the need for rigorous genetic analysis of these cells,' the authors wrote in their paper.

Researchers are currently investigating embryonic stem cells for their potential use in regenerative cell replacement therapies because they have the capacity to self-renew and develop into a variety of cell and tissue types such as blood cells, neurons, bone and muscle.

Scientists, however, recognise that genetic changes occur in a number of hESC lines as they multiply in the laboratory, and these changes can resemble the DNA (deoxyribonucleic acid) abnormalities often found in cancer cells. In addition, hESCs may also experience other genetic changes that traditional methods fail to detect. As a result, serious concerns remain over their use in the medical world.

The team used high-resolution DNA analysis to map genetic changes in 17 hESC lines cultured over many generations and maintained in different laboratories. Their analysis identified 843 copy number variations (CNVs), and on average, 24 % of the loss of heterozygosity (LOH) sites and 66 % of the CNVs changed in culture between early and late passages of the same lines, the authors wrote. CNV and LOH are genetic variations that could be linked to tumour transformation. They discovered that 30 % of the genes with CNV sites had, according to the authors, 'altered expression versus samples with normal copy number states, of which more than 44 % were functionally linked to cancer'.



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'When we know which genes are involved, it will be easier to reject those hESC lines in which those genes are more likely to mutate,' explained co-author Peter Andrews, a professor from the Centre for Stem Cell Biology at the University of Sheffield in the UK, and leader of the Estools consortium.

The Estools team is made up of 21 partners (18 academic research institutes and 3 companies) from the Czech Republic, Finland, Germany, Israel, Italy, the Netherlands, Spain, Sweden, Switzerland and the UK. The project partners say training and dissemination activities will help maximise the impact of their research, and develop a strong, competitive European base for human ES cell research.

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 16113

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

Directing the cell cycle show

Cell cycle control could provide the answer to many of agro-industry's dreams including maximum crop yield. Plant scientists in the EU-funded 'European cell cycle consortium' (ECCO) project have studied potential molecular candidates that play a major role in this important process.

The cell cycle is the series of events ultimately leading to cell division. Controlling the cell cycle may be one key to switching cell division on and off as needed. As such, scientists would then have a lever on the plant calendar — from germination and growth, right through to reproduction.

One major group of genes implicated in cell cycle control in plants is the F-box family. The model plant *Arabadopsis* may be small but its genetics have revealed some large surprises in this area. Research has shown that it has several hundred F-box protein genes compared to yeast, for example, with only a few.

ECCO scientists aimed to identify members of this group of proteins from the encoded F-box genes that play a role in the cell cycle. The approach they took was to identify the substrates of the F-box proteins, that is, their molecular targets. If the substrates were cell cycle proteins, then it follows that the corresponding F-box representative has a role in the cycle.

The project researchers devised a strategy to identify these protein substrates. They used an unsuspecting carrier, a pathogenic bacterium *Agrobacterium* which causes plant tumours. During infection, the bacterium transfers its own DNA as well as material added by the plant scientist.

Wild type proteins and those with the F-box portion deleted were studied and compared. As the proteins form a complex with their substrates, these were purified, analysed and identified. Processes used included the relevant versions of chromatography, electrophoresis and spectrometry.

The results were very encouraging and point to at least two F-box proteins with a potential role in the cell cycle. Information on the structure and function of proteins is a very useful tool. For the future, protein engineering can induce these molecules to halt or promote plant cell division as required.

Funded under the FP5 programme 'Life quality'
(Quality of life and management of living resources).
Collaboration sought: information exchange/training.
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Activators and repressors in the same family

Which genes make a plant grow, and how, is crucial information for improvement of crop performance. Researchers have investigated a group of genes with diverse roles in the universal process of cell division.

Cell division is a common denominator for all forms of life. Essential for growth and reproduction, it is not surprising that animals and plants and even lower forms share genes that control the process.

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Interested in the plant cell cycle, the EU-funded project 'European cell cycle consortium' (ECCO) project looked to a group of genes found in animals with a role in cell division. One is the so-called E2F gene that has a role in tipping the cell beyond the point of no return to undergo cell division.

A family of E2F genes can also be found in higher plant cells. The project team working at the Centro Nacional de Biotecnología in Madrid aimed to sort out the roles of this group of genes. Some appeared to activate cell division and yet, close relatives repressed the process.

One way to prove a gene's functioning is to partner it with a reporter gene that causes a change in colour in tissues where it is being encoded. The ECCO team of scientists used the beta-glucoronidase (GUS) reporter system where an assay shows the coloured area of any E2F activity.

Using transgenic plants specially created for the purpose by ECCO project partners, tissues with E2F activity were identified. Function and activity, it appeared, depended on the type of E2F protein present.

One was a promoter in meristematic tissues where division is taking place and the cells do not have an identity as yet. Another, E2Ff, was active mainly in young cells that had a specific function and form. In these growing differentiated cells, the researchers concluded that the gene showed change of expression and could act as a repressor, stopping the coding of its own gene.

Genetic control of the cell cycle is complex. As the functions of the proteins involved change with their environment, the process becomes more involved. This ECCO research has helped to unravel one small piece of the cell cycle so genes can be manipulated to improve crop yield.

Funded under the FP5 programme 'Life quality'
(Quality of life and management of living resources).
Collaboration sought: information exchange/training.
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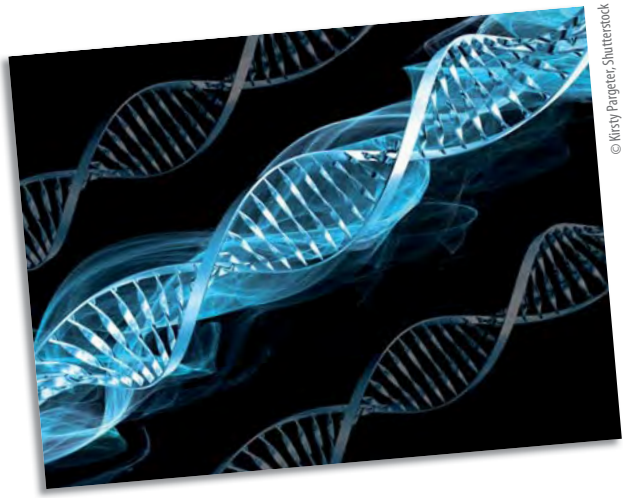
On the right path in genomics research

EU-funded researchers are shedding new light on the highly complex mechanisms controlling the activity of our genes.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The results of the three-year European project 'Genetic networks: emergence and complexity' (Gennetec), funded with EUR 1.48 million under the 'Information society technologies' thematic area of the Sixth Framework Programme (FP6), will help take the potential of genomics a step further with new ways of identifying the regulators controlling specific genes.

In organisms ranging from bacteria to human beings, genes are constantly being switched on and off. Genomics is the study of the workings of this complex web of genes and the factors that regulate them.

The molecules that switch genes on or off are called transcription factors or genetic regulators and researchers are currently trying to find the mechanisms that operate them. The Gennetec project set out to identify which transcription factors regulate which genes.

Transcription factors bind to particular sites on a chromosome to turn nearby genes on or off. The consequent pattern of gene activity is responsible for a cell or organism's development, function and response to environmental challenges and stimuli. Malfunctions in this system can cause diseases including cancer. 'A disease might sometimes be considered an improper change in the dynamics of a network of interactions,' said Dr François Képès from France's Centre National de la Recherche Scientifique (CNRS) and coordinator of Gennetec. 'So understanding their properties and how to correct or control their dynamics is essential.'

Until recently, researchers had looked for short deoxyribonucleic acid (DNA) sequences that were known to bind to specific regulatory molecules in order to try to match genes with possible transcription factors. But the drawback of this method is that it leads to many potential connections that later prove false.

The Gennetec team undertook a new approach for studying transcription factors. In a previous study they had found that genes which respond to the same transcription factor are often placed at regular intervals along a chromosome. The team suspected that grouping the transcription factors and related genes together helps to optimise their functioning. In order to prove that the locations of these genes help to determine the structure of a particular strand of DNA, the team used numerical simulations of DNA folding.

This enabled them to identify gene-transcription factor relationships much more efficiently. 'Combining the two predictors allows us to anticipate the regulators of a particular gene much better by cutting down on the false hits,' explained Dr Képès. 'We typically double the specificity of the prediction,' he added.

'What we discovered is that there is a clear link between chromosome structure and gene expression, a link that we can now predict in a very precise and workable way. We're now in a better position to understand genetic regulation in human cells for a lower cost and in a shorter time.'

One of the Gennetec partners, NorayBio, a biosciences software company based in Spain, is already developing software to allow researchers all over the world to use the same approach to analyse networks of genes. The Gennetec consortium has also made its own simpler version of the software available free of charge.

Dr Képès says the consortium's research on complex genomics systems is as important as the new software, as it can be applied in diverse fields including engineering systems. 'Cells have just one genome, but with that one genome they can cope with multiple challenges,' he commented. 'We can use this biological solution as inspiration to make a new generation of algorithms to address complex problems better than before.'

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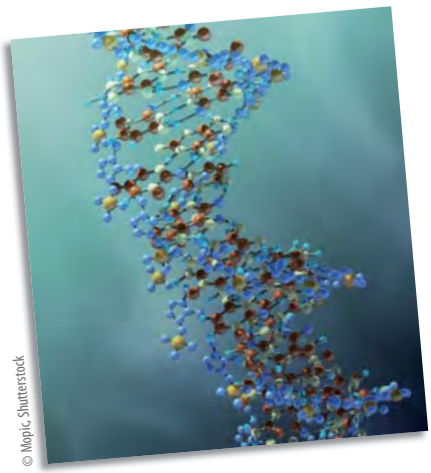
Jumping genes bridge the information gap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Inserting genes into foreign DNA can replace faulty code and identify gene function. Researchers with the EU-funded project JUMPY([1]) have devised a new way of delivering these genes that avoids several genetic pitfalls.

Sequencing DNA is the easy part of unravelling the genetic secrets of life. Actually defining the function of a gene is the difficult part. Scientists have been trying to narrow this information gap for some time. Recently, the JUMPY project has made considerable progress using an ingenious combination of state-of-the-art genomic techniques.

The researchers used an efficient vehicle to move foreign genes into the western clawed frog, *Xenopus*. The sleeping beauty (SB) transposon system is a non-viral gene carrier system that can insert a new sequence into the genome. For the JUMPY team, one considerable advantage was that this particular method can be scaled up.

The next step was to upgrade a method that inserts the mutations into a genome. The JUMPY scientists had previously developed a gene trap process known as restriction enzyme mediated insertion (REMI). Changes made by the project restricted chromosome damage and genetic instability that had interfered with the identification of the newly inserted mutations, or transposons.

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Using this so-called gene trap approach, a DNA sequence can be inserted that is not normally expressed unless it has been cut into, or near, a chromosomal gene. The net result is that this disrupted gene can then be identified.

After engineering the gene trap transposons, the researchers then further refined them for a range of strategies involving insertion. One particularly important criterion was that of efficiency. Increase in size of the transposon decreases transfer rate. Overall, they reduced transposon length significantly by up to 40 %.

Movement of genes into vertebrate organisms is important as genetic changes are induced and the effects can be seen *in vivo*. The hope is to be able to extend the study of functional genomics into other vertebrates like the mouse and zebra fish.

(1) 'Transposon-based strategies for functional genomic analyses in *xenopus tropicalis*, a vertebrate model system for developmental and biomedical research.'

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources).
Collaboration sought: information exchange/training.
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Fast tracking endocrine disruptors

Endocrine disrupting compounds interfere with the function of hormones in animals. Members of the EU-funded project ACE(1) have developed new analytical methods to speed up their detection at much reduced concentrations.


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To the detriment of the global food web, endocrine disruptor chemical (EDCs) are everywhere. Sources include pesticides, plastics and consumer products such as upholstered furniture. As well as a direct effect on the endocrine or hormone system, an additive or synergistic effect is suspected. This means that a cocktail of EDCs may have a greater impact than any one of its components on its own.

An important part of the assessment of the effects of EDCs is to extract them from their environment. These include waterways, run-off surface water and waste sludge. A sensitive, accurate assessment of concentration of the chemical is then needed to determine the length of exposure to the pollutant.

The ACE researchers used some of the most common EDCs in their assay tests. At the top of the list are the oestrogenic hormones or those having an effect on the primary female hormone oestrogen. Oestradiol (E2) is the number one female hormone and ethynyloestradiol (EE2) is one of the main ingredients of the contraceptive pill.

To separate the compounds from a range of liquid mixtures such as run-off water and sewage sludge, a revamped version of solid-phase extraction was used. Accelerated solvent extraction (ASE®) uses common solvents at raised temperatures and pressures.

The success of the new approach is self-evident in the results. The detection limits for the two hormones are in the low nanogram range — from only 0.2 to 1 ng/litre for E2. Out of a sample size of 220, 95 % of E2 on average was recovered, a very significant result.

Being able to extract these pollutants from a range of environments is a major step forward in proving exactly how devastating their effects can be. This may well affect not only marine and freshwater animals, but those further up the food chain.

(1) 'Analysing combination effects of mixtures of estrogenic chemicals in marine and freshwater organisms.'

Funded under the FP5 programme EESD
EESD (Energy, environmental and sustainable development).
Collaboration sought: further research or development support.
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Lamination signals tumour invasion

Different stages of cancer have their own molecular signature. Researchers in the EU-funded Proteases(1) project have identified a protein that could act as a chemical indicator of the extent of tumour invasion.

The progression of cancer is a complex web of cell and tissue remodelling. A series of molecular changes directs exactly which of the chemical pathways is going to occur. Doctors can therefore use the presence of particular molecules as markers to identify a stage of the cancer.


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Researchers with Proteases searched through the tumour cells of almost 100 patients with primary colon cancer to find suitable molecular candidates. Overall, the aim was to link a definite stage of the cancer with a certain amount of a marker.

In the path to colon cancer invasion, two stages can be important to the oncologist — Dukes' stage and tumour budding. Dukes' stage is crucial because it marks the spread of the cancer beyond the inner lining of the colon to the lymph nodes outside this stretch of the large intestine. Small clusters of cells with no identity as yet lie ahead of the cancer at the tumour budding stage.

As a reliable marker, one protein stood out as a candidate. Laminin-5 gamma 2 chain is part of the laminin family of proteins. As a group they are involved in a lot of important cell stages including development of cell type, differentiation, and signalling

To see if laminin-5 gamma 2 chain was present, the cells were scored for presence of

staining. Ratings for the amount of staining ranged from sparse, moderate to frequent. Normal cells were negative for the stain. In contrast, there was positive staining in 96 % of the tumours.

The link between frequency of staining for the laminin and the cancer stages held true. There was a very positive association between the presence of the gamma 2 chain protein and Dukes' stages A to C. The same level of correlation with tumour budding was observed. Overall, the study showed that the concentration of laminin-5 gamma 2 chain increases as the cancer progresses. Levels of the protein also rise as the disease becomes more aggressive.

Stage of the cancer determines effective, timely treatment. A reliable marker for the extent of invasion of colon cancer has been identified. As this disease is the second most commonly occurring cancer in Europe, these findings are significant in the drive to improve the health of our ageing population.

(1) 'A paradigm for the establishment of new prognostic markers for common cancers: protease systems as indicators of invasive potential.'

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 > 5433

An early warning system for cancer

In the fight against cancer, gauging how inherently susceptible a person is to the disease can be an important diagnostic tool. EU researchers have looked to changes in chromosome structure for cytogenetic biomarkers.

Effective treatment of cancer can depend on early, accurate diagnosis. One of the ways to help achieve this is to know the likelihood of developing the disease in advance. Although predisposition through family history is an indicator, the use of biomarkers gives doctors and patient a head start by using the most appropriate therapy.

Changes in the structure of chromosomes can be easily identified in laboratories with appropriate staining and microscope work. So-called chromosomal aberrations (CAs) can therefore act as biomarkers.

These CAs — even though all material may be present — can cause genetic chaos in the individual with the development of cancer a possible outcome. It seems that genes must be present not only in the right quantity but in the correct place.

With funding from the EU, project scientists with 'Cytogenetic biomarkers and human cancer risk' (Cancerriskbiomarkers) set out to ascertain whether CAs reflect individual susceptibility factors. It would then follow that there is a link with the risk of developing cancer. Also monitored were so-called micronuclei (MN) that form as a result of small bits of chromosomes being left outside of the nucleus.

Cell material was analysed from people living in five European countries. The scientists looked at lymphocytes, a type of white blood cell circulating in the blood for evidence of CAs and micronuclei. Associations with external factors such as age and smoking were recorded.

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Also monitored were levels of enzymes that can come into play in the event of damage. Cells have an arsenal of enzymes that help to repair deoxyribonucleic acid (DNA). Extra cell protection comes from special enzymes that break down cytotoxic chemicals such as antibiotics.

The search for external factors that affect chromosome structure revealed some important links. Presence of damage repair enzymes affected numbers of CAs and micronuclei in many cases. Perhaps as expected, smoking and age were also associated with certain types of CA as well as micronuclei.

Overall, both the chromosomal and external environment present a very complex set of options for damage and change to the cell's genetic code throughout a person's life. Although data from this extensive research suggests that changes at the chromosome level could be used as a measure for predisposition to cancer, it is clear that much more information must be collected.

Eleven countries across Europe were represented by partners of this project. European funding has provided the opportunity to collect information for the beginnings of an extensive database. For the future, this will be one more weapon for the battle against cancer.

Funded under the FP5 programme 'Life quality' (Quality of life and management of living resources). Collaboration sought: information exchange/training. http://cordis.europa.eu/marketplace > search > offers > 5424

Nutraceuticals for the sweet tooth

As nutrition for developing mammals, milk has the potential to be a complete food. Researchers have enrolled the help of microbes to boost the dietary value of milk-based products as well as eliminating a source of food intolerance.

Fermented dairy foods rely on naturally occurring microbes to not only preserve the product but to give the taste the consumer demands. With biotechnology at their fingertips, microbiologists are able to either select naturally occurring mutants or modify these one-cell labourers. This way, food products can be made to order.

Scientists with funding from the European project 'Nutra cells'(1) worked on improving fermented dairy products like yoghurt. The aim was to make this popular healthy dessert with much reduced lactose and increased glucose as a natural sweetener.

The bacterium normally involved is *Lactococcus lactis* which, as the name suggests, ferments milk sugar (lactose) to give lactic acid, a preservative. Increasing the

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appetite of the bacterium for lactose successfully reduced the amount of lactose remaining in the food, ideal for the consumer with an intolerance for the sugar.

The bacterium also uses glucose as an energy source and has all the necessary biochemical equipment for its breakdown. This means that any glucose present from the splitting of lactose into glucose and galactose will be used by the microbe.

To increase glucose content, the researchers deleted three genes to block its metabolism. Techniques used to study the genes involved in the breakdown of the sugar included nuclear magnetic resonance (NMR) live in the cell and tracking radioactively labelled glucose. To complete the molecular picture, transcriptome analysis was then used to sequence the deoxyribonucleic acid (DNA) and identify genes.

Further development of this research lends itself to genetic modification and the production of other prototype bacteria to do the job. The food industry and the consumer both stand to benefit from tailor-made food which is not only healthy but potentially inexpensive to manufacture.

(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.
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Zinc for the Zenith of health

Cell damage due to the accumulation of highly reactive free radicals has been implicated in many diseases associated with old age. European researchers have investigated whether zinc supplements can reduce this so-called oxidative stress.

Zinc, a micronutrient, is involved in a huge number of the body's biochemical reactions. Its role lies at the very core of the cell machinery as it is required in protein and deoxyribonucleic acid (DNA) synthesis and every step of the cell cycle.

As zinc is found in a broad spectrum of foods including meat, unrefined carbohydrates, beans and seeds, a good diet will provide the daily required dose. However, in groups like older people, there is a possibility of deficiency due to decreased food intake coupled with reduced absorption.

With the help of EU funding scientists in the project 'Zinc effects on nutrient/nutrient interactions and trends in health and ageing' (Zenith) explored the role of zinc in healthy old people, aged 70 to 85 years. Over a six month period, two moderate doses of zinc were given to gauge the effects, if any, on reactive oxygen-induced damage.

Indicators of oxidative stress were measured in a group of some 100 recruits from Rome. Anti-oxidants involved with metabolism or breaking down of reactive oxidative molecules were measured in plasma and lymphocytes. These included carotenoids, beta-carotene and co-enzyme 10. Also measured were several enzymes involved in reactive oxygen metabolism.

The data collected was extensive. To ensure a valid experimental setup, dietary intake of the relevant anti-oxidant micronutrients carotenoids, retinol and vitamin E were monitored. As copper and iron are associated with zinc metabolism their levels were also measured.

Effects of zinc supplementation for independent old people in Rome showed that the doses taken did not significantly change levels of these biochemical markers of oxidative stress. Zinc supplementation for healthy old people does not appear to be an efficient way to increase anti-oxidant defence.

When tackling the problems of an ageing European population, prevention is better than expensive treatments. Diet is at the heart of a healthy lifestyle accompanied by the sensible use of supplements.

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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The science of slowing down in life

European funding has enabled researchers to see if zinc levels affect metabolic rate during ageing. Possible factors investigated included thyroid hormone levels, body fat, age, and even the country of residence.

To improve the health of any population by diet — and possible supplementation — extensive trials are necessary. Academic and business cooperation across Europe has given the project 'Zinc effects on nutrient/nutrient interactions and trends in health and ageing' (Zenith) project an opportunity to study the effects of the mineral zinc on the energy flow of middle-aged and older Europeans.

The body's energy management is a delicate balance between intake, rate of production and use in the cell, and storage, for example as long-term fat. Implications of how the body produces and uses its energy have far-reaching effects on health, the fate of fat in the body being one classic example.

One group of project scientists focussed on the possible link between zinc levels and thyroid hormones as well as related variables like fat-free mass. This index links muscle mass to height. Thyroid hormones largely control the rate of metabolism in cells. The scientists measured both T4, the inactive form produced by the gland and T3, its active form in cells.

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The randomised double blind trial studied a total of almost 400 volunteers from four centres in France, Italy and Northern Ireland. Both men and women aged from 55 to 80 years were monitored.

Tried and tested methods were used to measure the variables. Fat percentage and lean body mass were estimated using a skin fold caliper on four key areas of the body. Energy expenditure was calculated indirectly by measuring uptake of oxygen and output of the waste gas carbon dioxide. Not only is this accurate but it is clinically feasible.

Data collected showed some statistically significant differences between countries in Europe. One notable example was that the Italians tend to have a lower fat free mass and basal metabolic rate (BMR) than their French counterparts. Generally, an age-related decline of BMR was confirmed but this could not be explained by thyroid changes or body composition.

After peaking, a gradual slowing down of metabolism as the years go by is a fact of life. To be aware of the scientific reasons behind this means that the information can be used to maximise the health status of Europe.

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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The brain: probing its deep mystery

We know more about the cosmos than we do about the human brain, but work by European researchers will now allow scientists to probe further into the mysteries of our grey matter.

We know the cosmos better than we do the ocean floor, but even the ocean floor is better understood than the human brain. Estimated to contain 50-100 billion (10^{11}) neurons, and these cells pass signals to each other via as many as 1 000 trillion (10^{15}) synaptic connections, the brain is a vast territory.

But it is not just the staggeringly large geography of the brain that makes this final frontier deeply mysterious; even where behaviour is predictable and reliable the reasons for this behaviour often remain unknown.

'Nowadays an implant that has gathered a lot of interest is the deep brain stimulator for Parkinson's disease,' notes Herc Neves, scientist at IMEC and coordinator of the project 'Development of multifunctional microprobe arrays for cerebral applications' (Neuroprobes). 'It works, but we don't know how it works.'

Even when researchers succeed in combating a terrible disease, the fundamental mechanism remains deeply mysterious.

'Part of the problem is that we do not have good visualisation. It is not an imaging problem; what I mean is that we cannot see what is happening at a cellular level. We have some very, very interesting tools like functional magnetic resonance imaging (fMRI) that [give] us a pretty good idea about the inner workings of the brain, but this is at a macro level, not a cellular one.'

So processes can be difficult to see; but even then understanding how the processes interact is a huge undertaking. 'A Pentium computer chip has probably the processing power of a beetle brain. Even the retina, an extension of the brain, has many times the processing power of a Pentium chip. So we are a long way from being able to mimic the complexity of the human brain.'

Probes are a key technology to understand the fundamental mechanisms of the human brain at a cellular level. And this understanding provides the essential information to combat some of the most tragic and debilitating diseases known to man, including Alzheimer's, Parkinson's, schizophrenia and many others.

Probes are one of the key tools used by neuroscientists. They come in a variety of types and forms, and while they have been around for a while they have only enjoyed incremental advances over the last decade. Typically, they sense particular activity at a given location. Neuroscientists use them to study in detail areas highlighted by fMRI, for example.

Neuroprobes began its work by asking neuroscientists what was their wish list for 21st century research tools. 'And they replied that, despite all the effort that had been going on to develop better probes for the brain, there was still a huge gap in terms of the needs of the community,' notes Mr Neves.

By looking at the requirements of neuroscientists, the project was able to develop the specifications for a new probing platform.

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From an early stage, researchers decided that the new platform would be modular, so researchers could mix and match elements within the system.

'Because for starters, the brain is as much chemical as electrical,' stresses Mr Neves. 'So it was highly desirable to combine chemical sensing and actuation with electrical sensing and actuation. And very quickly we realised it was really something we could tackle in a modular way,' he adds.

Different groups specialising in different aspects of the technology, or different technologies, delivered their results independently and Neuroprobes combined the results into an overall platform.

Built into this modular approach was the concept of efficiency. 'While [trying] to answer the needs of neuroscientists within the project, we stuck to standard fabrication processes and varied things as little as possible.'

The team also designed the platform to work in three dimensions, another novelty. In most modern probes, the active sensing and actuation elements are either in the vertical or horizontal plane. In Neuroprobes, both planes can contain active elements simultaneously, making it vastly more flexible.

It was a big challenge, but the consortium proceeded cautiously. The first year was a catch-up phase, proving the new platform could produce probes that were at least as good as the best available.

'It was a risk reduction approach. We wanted to start and become familiar with the platform doing something we knew we could do, then progressing in the second, third and fourth years to more ambitious probes,' declares Mr Neves.

It worked for the neuroscientists, too. They were already testing Neuroprobes by the end of the first year, and in this way, they could become familiar with the new platform before it became too complex.

'Neuroscientists, for very good reasons, are quite conservative,' reveals Mr Neves. 'They prefer to stick with something that they know works reliably. Their work is sufficiently complex as it is, and so one of our major challenges was to prove that our platform could do as well or better than some of those standard electrodes. So we also designed our platform to work with whatever bench tools they had in the lab.'

The electronic depth-control probe was a special case, though. This particular probe was a major breakthrough for the project and, given its usefulness, neuroscientists have been very willing to experiment with the unfamiliar to access its functionality.

The electronic depth-control probe allows neuroscientists to accurately position individual electrodes with respect to cells. It was something the team realised during the project, as work continued it became obvious such a probe was both feasible and highly desirable, according to Mr Neves.

Initially, the team thought to move the probe mechanically in order to position it precisely. But while mechanical movement aligns one electrode, it could knock others out of position, and there was a risk of irritating the brain tissue, possibly leading to inflammation.

During a brainstorming session, the Eureka moment came when the team realised they could virtually move the probe by electronically switching through a very large number of electrodes to get the best possible alignment with a given number of individual cells. It is something no other probe can do and neuroscientists are eager to use it.

The novelty of the probe meant the project team had to develop new control software, but even here the consortium was keen to cause as little disruption as possible, so they developed a simple and intuitive control interface. 'Even a non-specialist would have no trouble understanding how to use the probe,' Mr Neves states.

In all, Neuroprobes has significantly advanced the state of the art in neurological probing, developing a complete platform that serves everything from sensing and stimulation to data readout and recording on bench monitors. The platform will enable neuroscientists to move beyond the single electrode rods currently in vogue, to multi-electrode and micro-fluidic devices that enable more sophisticated and ambitious experiments.

The project's work has been remarkable, but in many ways the greatest impact from the Neuroprobes research has yet to come; the insights and research breakthroughs that will lead to healthier brains in the future.

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

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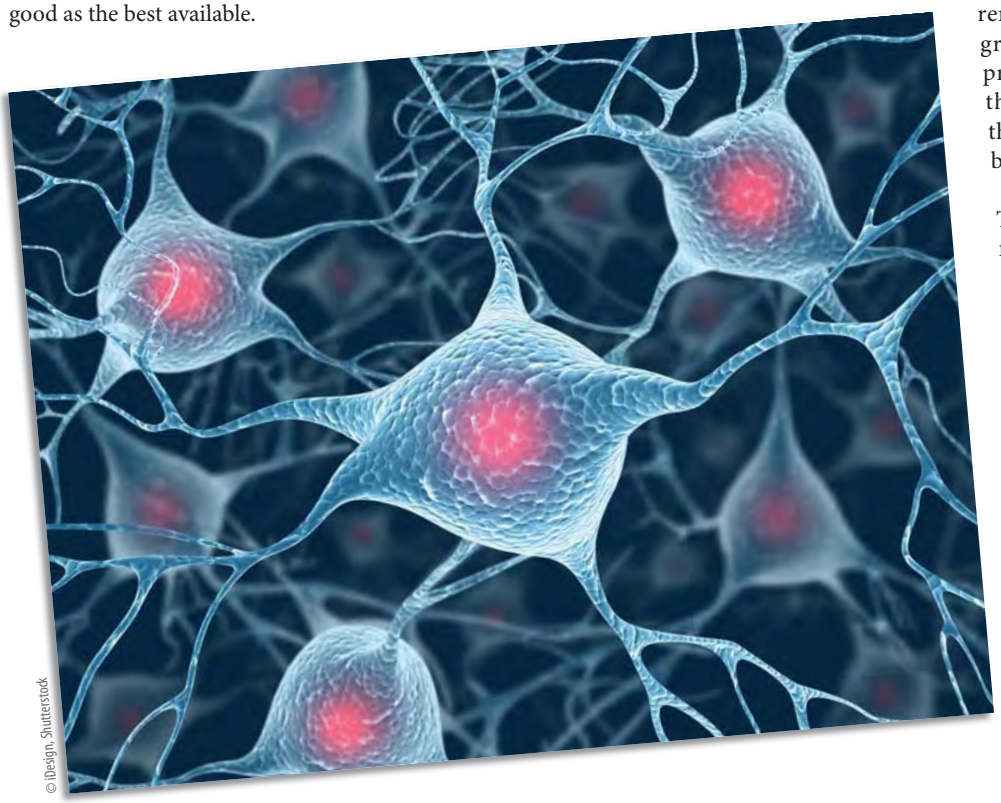

The dangers of live vaccines

Vaccination can help to control outbreaks of bluetongue virus (BTV) but safety is a key issue. Working in the field, European researchers have identified specific risks linked to the use of live vaccine viruses.


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Bluetongue virus outbreaks in southern Europe have prompted the vaccination of animals most at risk. In a bid to be more effective, vaccines use strains of the live BT virus. The virus is weakened, or attenuated, to render the virus non-pathogenic but many experts believe that the use of live viruses may pose future problems. A group of scientists from the EU project 'Bluetongue vaccination' investigated exactly how.

Genetic differences between types of animals affect susceptibility to the virus, for example. Project trials showed that even though virulence is disabled to a certain extent, certain breeds of sheep can show clinical signs of the disease.

Use of live vaccines may also be inadvertently helping an evolutionary process to occur by creating new strains of the disease. When livestock have the disease and are then vaccinated, the different sources of viral material can combine in the affected animal to produce new virus strains. Proof of this came when the project scientists actually found previously unknown viruses in the field that resembled the vaccine viruses.

As expected, the life cycle of the virus plays a major role in determining control strategies. Bluetongue is not contagious but spread by a so-called vector, in this case the *Culicoides* midge and this has far-reaching implications. The unprecedented spread of the disease to northern Europe is partly due to the increased range of the vector.

The project team found that the vaccine virus can cause a level of virus in the blood, enough to infect the insect vector. The virus then multiplies in the midge, sufficient to transmit to another animal. However, the good news is that there is no evidence of an increase in the virulence or ability to infect while the microorganism is in the insect.

Identification of risks from field conditions will help the agricultural authorities to formulate the most appropriate control measures against the disease. Sustainable vaccination programmes will no doubt be an important part of the overall recommendations and countermeasures.

Funded under the FP5 programme 'Life quality'
(Quality of life and management of living resources).
Collaboration sought: information exchange/training.
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Breeding virus out of salmon stocks

Intensive farming practices in aquaculture encourage the development of disease such as pancreas disease. Harnessing natural resistance of Atlantic salmon to this insidious virus could be a sustainable solution to the problem of stock infection.

Aquaculture is one answer to overfishing dwindling stocks and meeting the demand for fresh fish. As usual, there is a price to pay. An overcrowded pool of only one fish species is the dream of an infecting microbe. Once stock becomes infected, huge losses may occur. Disease prevention has therefore become priority for the fish farming industry.

In the case of pancreas disease (PD), there is a vaccine. This, combined with careful stock management can be effective against infection. Perhaps a more sustainable option is the development of resistant strains of salmon. No susceptibility to the disease means viral infection would be impossible.

With funding from the EU, the project 'SPD/SD diagnosis'(1) investigated this possibility by looking at different susceptibilities of wild salmon smolt to PD. The scientists devised a series of trials to monitor the extent of effects of PD on the fish.


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Three different strains of Atlantic salmon smolt were infected with the virus. Each fish type had its own seawater tank. Pancreas disease affects not only the pancreas but the heart and skeletal muscles. To assess damage, samples of affected tissues were scored for viral lesions over a total period of 42 days.

Another approach involved assessing the actual amount of virus present in fish serum. For this, a so-called end-point virus neutralisation was carried out. This gives a very accurate picture as the serum samples are diluted until no positive result for the presence of virus is detected.

The results give a positive boost to the argument for breeding resistant fish. This appeared to be particularly true at the smolt stage when the fish make the transition from fresh to seawater.

As more research is required into the mechanisms behind resistance to the virus, a future research schedule was planned involving specialist smolt producers. Identification of the genes and proteins involved can be important in management of future breeding programmes.

Pancreas disease can cause significant losses due to morbidity, mortality and reduced production. Stocking fish farms with resistant strains of salmon would seem to be a viable solution.

(1) 'Diagnoses, pathogeneses and epidemiologies of salmonid alphavirus diseases'.

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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The automotive internet, from vision to reality

European researchers developed a vision for a new, cooperative traffic system based on advanced communication hardware and software, a kind of automotive internet; they also created all the necessary enabling technologies. So when will an automotive internet become reality?

We have the technology; we can build an automotive internet… a communications infrastructure that can enable any number of new applications to dramatically improve the safety, efficiency and reliability of driving. This is the vision of the EU-funded 'Co-operative vehicle-infrastructure systems' (CVIS) project.

The question remains: can it be done and, if yes, then how and when?

Deploying an 'internet of traffic' is a vast task that can learn some lessons from the internet of yore which relied on computers, modems and phone lines to provide the most basic of surfing experience.

But the automotive internet is starting out with even more humble beginnings, as most cars in circulation do not come equipped with built-in mobile communications; those that do often use a proprietary system that does not 'play nice' with other technologies.

CVIS plans to change all that. The technologies developed by the consortium are reasonably inexpensive (per unit) considering what needs to be installed to make up for a lack of roadside communications infrastructure communicating wirelessly with passing vehicles.

But like every aspect of the project, CVIS has thought long and hard about how its technologies could and should be sensibly deployed.

A key aspect of the project's efforts to break new ground has been a determination to quickly involve third-party application developers and service providers.

Nearly two decades after it started, mobile-phone data communications is still a relatively tiny market, because mobile operators have tried to remain 'gatekeepers' of the service, preferring to buy in applications from third parties rather than letting developers create their own business on the network.

As a result, mobile data applications tend to be expensive, difficult to use, rarely innovative and a very small part of overall telecoms revenues. Consumers are thus less interested in what the operators have to offer.

But CVIS is taking a much more open, 'free market' approach, enabling third-party application and service providers to share in the profit. All evidence indicates that this leads to rapid application development, faster user adoption of new technology and greater profits for everybody. NTT's iMode service was an early example, Apple's iPhone App Store is a more recent one.

In a canny move, CVIS hopes to leverage the same process to boost deployment of its hardware, software and service environment.

Moreover, there is a flourishing market developing in 'machine-to-machine' or M2M communication, using simple cellular data modems in fixed or mobile equipment to create new revenue streams for mobile telecom operators. CVIS is something like M2M in a mobile scenario.

Nonetheless challenges remain before the complete system gets deployed in any jurisdiction, but undoubtedly CVIS has many factors in its favour, not least of which is the support of governments and stakeholders in the industry.

The lead partner and coordinator of the project is ERTICO-ITS Europe, a public-private consortium gathering all the major stakeholders together in a bid to deploy cooperative vehicle infrastructure systems.

Apart from a compelling platform and some big European industry behind it, CVIS benefits from one other crucial advantage: realistic expectations.

Paul Kompfner, head of sector, cooperative mobility, at ERTICO-ITS Europe, and coordinator of the CVIS project, believes in organic growth. In this scenario, resources gather naturally in specific areas where they can enable really compelling applications with immediate effect and large benefits. Later, other applications can be deployed at these nodes, starting a virtuous circle that can establish an ever-wider arc of infrastructure installation and application development.

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For example, one of the large-scale tests that generated enormous interest among the users was parking reservations for delivery vans and trucks. For obvious reasons, traffic management is extremely strict in cities like London, so if there is no free loading bay to take a delivery the truck must go around the block again.

Unfortunately, given the one-way systems in use, that 'block' can be up to eight kilometres long and heavily trafficked. Going around again can take a long time and adds to the cost of fuel, emissions and congestion resulting from a failure to move trucks in and out of the city efficiently.

The CVIS solution is compelling. Trucks 'book' a loading-bay spot in advance and get a reservation time and duration. The reservations are managed by software and executed through wireless nodes, and are automatically updated if the truck is ahead of or behind schedule — like airport landing slot management.

During the field test, Coca-Cola, one of the participants, was astonished to discover that they could save EUR 100 000 directly each year, at one delivery location, just by being able to reliably unload at their destination. The potential savings across the entire city of London, or across the UK or across the continent are literally staggering.

'These nodes are not terribly expensive,' notes Mr Kompfner, 'When in mass production they should cost only a few 10s or 100s of euros each. Of course, if you had to roll them out all at once across the country, the cost would be astronomical,' he notes.

However, companies like Coca-Cola, which was involved in the loading-bay demonstration, would be very happy to pay a subscription if it would help underwrite the cost of the infrastructure at highly desirable locations.

"And once the infrastructure is in place for one application, it can be used by any other application, too," Mr Kompfner stresses. So once a communication point is deployed at a particular location for the loading-bay application, another application could be rolled out at no extra cost, for instance for private car parking, traffic light information or traffic data collection.

This is how Mr Kompfner believes the cooperative society envisaged by CVIS will spread; relatively rapid deployment around highly desirable nodes pushing the early adopters.

Then, high-end private vehicles could start enjoying major advantages by being able to talk to this infrastructure. And we could see a massive, generalised spread of the technology along major arteries, followed by subsidiary routes over time — not unlike take-up of global positioning system (GPS), which just five years ago was a relative novelty.

So, the internet for automobiles could be coming sooner than we think.

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

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INTERVIEW

Into the control room: *research*eu results supplement* talks with David McMillan of Eurocontrol


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Mr David McMillan

David McMillan has been director general of Eurocontrol, the European organisation for the safety of air navigation, since 1 January 2008. Eurocontrol is an intergovernmental organisation with 38 European countries and deals with both civil and military aspects of air traffic management.

Its principal concern is to ensure that the European air traffic management system is safe, efficient, cost-effective and has the least possible impact on the environment. It is also a founding member with the European Commission of the SESAR Joint Undertaking, the body recently formed to coordinate the research and development needed for the realisation of the Single European Sky.

David McMillan previously held the post of director general of the UK Civil Aviation at the department for transport from April 2004. Prior to that he was director of strategy and delivery, responsible for the department's delivery agenda, business planning and relations with the European Union.

He had a long career at the department of transport and its predecessors, working in aviation, integrated transport and personnel. Key posts involved a stint as transport secretary in the British Embassy in Washington DC, acting as the secretary of state's press spokesman, setting up the UK's air navigation service provider (NATS) public private partnership, and securing the replacement of Railtrack by Network Rail as the UK's rail infrastructure provider.

David started his career in the diplomatic service and served in both Morocco and Zimbabwe. He has a degree in French and Spanish from Edinburgh University.

• When we say 'smarter, better transport' what is the first thing that comes to mind? And in relation to air transport/air traffic control?

I think that smarter, better transport is whatever best meets the needs of the consumer and of society. So there's no single solution — the needs of a commuter in Paris are very different to those of a student in Oxford. Our challenge is to respond to these needs and even to anticipate them.

In our field, air traffic management (ATM), the criteria we look at include safety, capacity, efficiency and the environment. So we're working to make aviation even safer, able to cope with anticipated increases in demand, more efficient — in particular more cost-efficient — and with a reduced impact on the environment.

• You've had a tough six months, with extreme winter conditions followed by freaks of nature like Iceland's volcano which hamper air traffic flow. How did the systems cope? Did you have a technology trump card? If not, is there any plan to develop a system to address this kind of phenomenon?

The weather was very severe — snow in December and extreme cold in January. Indeed, 21 December saw an average delay per movement of over an hour — the highest recorded daily figure since 2000. The ash caused further problems, both for passengers and for the airlines (who were already struggling financially). We've been doing what we can to help — both by reducing our costs and also by trying to cut the costs of airlines, for example by making routes more direct.

In terms of the ash from the Eyjafjallajökull volcano, we had two roles. We did not close airspace ourselves — that's the responsibility of individual Member States — but we managed the flow management implications of those decisions and communicated the situation to everyone. Here our existing systems actually coped very well. Indeed, our internet portal was receiving over 200 hits per second at one point! We also made extensive use of new forms of communication such as Twitter — which was extremely useful because of its immediacy and which was very well received both by the media and by the public.

Our second, and equally vital, role was in facilitating a solution. It was a teleconference hosted by Eurocontrol on Monday 19 April that proposed the revised approach that was accepted by transport ministers and led to aircraft flying again. The recovery was also a test for us — with a very dynamic and flexible response being required in a rapidly evolving situation.

Since then, this 'revised approach' has been further developed. We've also been asked by the European Commission to formally create a crisis management cell so the response to any future incident can be even better coordinated.

• The aeronautics sector is something of a pioneer — for example auto-pilot technology. Decades later and road vehicle makers are only just introducing such automated piloting and security systems. How do you see these sort of 'intelligent systems' evolving in transport? How far will we let them go?

It's clear that intelligent systems are evolving and that, on road and rail, they have the potential to enable the safe operation of vehicles in closer proximity. However, on the road side, equipage issues will be very significant. We're starting to see some separation sensors but only on the most expensive vehicles.

As regards aviation, although it can act as a pioneer, it is also very cautious. New developments are only introduced after extensive testing to make sure that they are safe. Aircraft also have extensive redundancy built in, for example a modern airliner doesn't just have a single autopilot — or indeed a single human pilot.

So, while automated systems have many real advantages and have saved many lives, they also have their limitations — you can't see an autopilot achieving what Captain Sullenberger did when he lost both engines and ditched flight 1549 in the Hudson early 2009. The way forward is to develop systems that 'support' the human, whether it's a pilot or an air traffic controller.

That said, we may well see unmanned aircraft over Europe — indeed we are already working on the procedures to allow Global Hawk aircraft to operate in controlled airspace. But I find it interesting that there's an increasing use of the term 'remotely piloted', reflecting an appreciation of the need to keep a human in the loop.

• Air safety and environmental sustainability are clear winners as science and technology improve, what other areas does Eurocontrol see as ripe for a technology makeover?

In fact, everything we do is connected to safety — and almost everything to environ-

mental sustainability. But let me choose a couple of areas where the link is not so obvious.

The first is our ground-based data infrastructure. We need to transform the way that air traffic control centres talk to each other across Europe. There is a new initiative on this, 'Pan-European network services' (PENS), jointly led by Eurocontrol and the 'Air navigation service providers' (ANSP), which will provide rapid and secure IP-based voice and data communication. It's a vital building block for the full 'System wide information management' (SWIM) within the SESAR operational concept.

The second is again data links but this time between the controller and the pilot. Many of the voice interactions between them can be communicated electronically — thus freeing up the voice channel and reducing the chance of clearances being misunderstood. This has been trialled with great success at Eurocontrol's upper air traffic control centre in Maastricht. It'll be rolled out across Europe over the next few years.

• The 'Single European Sky ATM Research' (SESAR) is the tech side of the Single European Sky initiative. What kind of exciting technology is SESAR developing to address the increase in air traffic congestion and the reduction of fuel and CO_2 emissions?

Central to the SESAR operational concept is the idea of a 4D business trajectory. This means that the entire flight of an aircraft is planned in four dimensions, including time, and is optimised to minimise fuel burn and to fit in with other aircraft. This trajectory is updated in real time to take account of developments, for example in the weather or in the availability of military airspace. Information on the flight, the planned trajectory and the weather is shared seamlessly with the ground-based controllers and with other aircraft.

This is not going to happen tomorrow — or even next year. However, we do now have a much better idea of where we want to head towards and what building blocks need to be put into place.

• European 'Geostationary navigation overlay service' (EGNOS) will be certified this year for the aviation industry. In your view, how does this improve upon the current system?

EGNOS is a valuable step forward because it significantly improves the accuracy of existing satellite positioning systems, particularly in the third dimension - altitude. This can be a real help, particularly for aircraft on approach where the airport is not equipped with an instrument landing system (ILS). It's being especially welcomed by the business aviation community.

The independent performance report (IPR), which supports the certification process of EGNOS, has been the result of intense co-operation between Eurocontrol, the European Commission and the European Space Agency. We've also developed an independent tool, Pegasus, to assess how to apply the relevant global standards.

We're looking forward to the completion of the certification of EGNOS and to supporting the operational introduction of EGNOS-based procedures.

• On a more personal level, how did you get involved in the air transport field in the first place (Was there a moment when you just knew this was for you?)

Careers develop in many and different ways. For me, I started as a diplomat before moving back to the UK and to the department of transport. There, my experience was particularly well suited to working on the international forms of transport — such as aviation. And I enjoyed it, not just because of the sense of drama and romance associated with flying, but also because it is fascinating and compelling.

So rather than any one single moment, it's been more a gradual and progressive journey into the field. And no, I'm not a pilot myself. I have a remarkable ability to crash flight simulators so I leave flying to the experts!

• In what ways to do you think air transport and especially air traffic control will evolve in the short and/or long term? (What are the main challenges?)

There is real potential for change. If you go into an air traffic control centre today, it will look very different to a centre 40 years ago. However, the controllers are still doing essentially the same job in much the same way.

That said, over the short term — say the next five years — the changes will be more structural than technological. We now have the Single European Sky II (SES II) legislation and we are already starting to see the impact of the formation of 'Functional airspace blocks' (FAB) — a first step in reducing the fragmentation of Europe's skies. A next step will be the introduction of a performance regime — in which there will be real incentives for air navigation service providers to improve their performance.

Longer term, we will see a fundamental change in how the controllers will do their job, with a move towards monitoring flights on pre-planned trajectories, rather than issuing a stream of instructions. This should not only help maximise capacity but also reduce fuel burn and improve safety. They'll also have an impressive range of tools to help them visualise the situation in four dimensions.

• What should research funding agencies do to make sure Europe stays on top of its game in transport research and especially air transport?. What areas do you think could be under-funded or under-researched?

The research agencies already support actively air transport research. Indeed, the SESAR Joint Undertaking is a good example where both the European Commission and Eurocontrol have joined forces and attracted key air traffic management industry players in a cohesive programme, based on the European ATM master plan. It's a real opportunity to maximise the benefit from the available budgets.

This is a step in the direction of the objectives of the Lisbon Agenda. However, in a sector which, as previously noted, has been

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hit by both the economic crisis and adverse natural phenomena, research funds are significantly below the target of 3 % of GDP. While over the last 15 years the flow of ATM research has been generally sustained (of the order of EUR 200 million per annum), lack of funding (and also of researchers) has resulted in tough choices being made, with medium-term research generally being favoured over the longer-term.

As a result, there is a risk of losing opportunities where more innovative solutions could be found using very advanced technologies — or where the inherent complexity of the air traffic requires a specific understanding of the interactions among the many players and how the overall performance of the system can be optimised.

We should not forget that the public sector has a major role to play in funding longer-term research. And such research is vital. For example, the environmental impact of aviation is a clear case of where we need to find radical solutions, so that we can continue to have an agile intermodal transport system in Europe.

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Algorithms provide a model of railway efficiency

If you've noticed that Dutch trains experience less delays or that waiting times are shorter on the Berlin underground you can thank a team of European researchers whose advanced algorithms are optimising rail services.

In what has been described as a breakthrough in the field of operational research (OR) and has garnered a prestigious award, the researchers succeeded in developing advanced algorithms able to optimise planning and scheduling in vast, complex rail networks.

In practice, their work means that railways can be more confident that their routing choices will allow more trains, more passengers and more goods to safely traverse the same infrastructure while increasing punctuality, passenger satisfaction and operator profit. It's a win-win for everyone.

It is not surprising then that many railway and transport network operators across Europe, from Netherlands Railways and the Berlin U-Bahn to Swiss Federal Railways and others, have implemented the technology or are planning to do so.

'We set out doing foundational algorithmic research, to develop universal algorithms and methods, we did not expect to see them being used in real-world applications so soon. But by now 95 % of our algorithms and methods have been verified with real-world data and many are being used commercially,' explains Christos Zaroliagis, a professor at the University of Patras and a senior researcher at the Computer Technology Institute in Patras, Greece.

Mr Zaroliagis coordinated the team behind the EU-funded Arrival([1]) project, which brought together researchers from seven European countries. Among them was a team from Erasmus University in Holland that had been working closely with Netherlands Railways on a new railway timetable. Together with collaborators from the University of Padua, Italy, the Dutch researchers were awarded the 2008 Edelman Award, described as the Nobel Prize of applied operations research.

Thanks to their work, much of it carried out in the Arrival project, the Dutch railway network is today one of Europe's most efficient.

'The Netherlands is a small country, but it has a very dense railway system that has to handle 5 500 trains per day. Trains literally travel one behind the other, so any disruption anywhere has knock-on effects that can lead to long delays and major scheduling problems,' says Mr Zaroliagis. 'The new timetable, drawn up using the Arrival algorithms, has meant that trains can be scheduled more efficiently and disruptions handled more effectively, while maintaining the usual security measures.'

As a result, trains suffer fewer delays, passenger surveys show higher levels of satisfaction, and Netherlands Railways' profits have risen by EUR 40 million per year — a figure that is expected to rise to EUR 70 million in the near future.

The key to such significant gains in efficiency lies in two approaches to optimised planning that had previously not been applied to the rail transport sector: robust planning and online planning.

The first approach involves deploying algorithms to ensure all aspects of the railway network, from train scheduling and platform allocation to staff distribution and freight loads, are organised as efficiently as possible, while still being able to absorb disruptions without impacting services too dramatically.

'It's a proactive approach. You don't have an optimal offline plan that can't handle disruptions. You have a near-optimal plan that can handle as much disruption as possible,' Mr Zaroliagis explains.

Online planning, on the other hand, takes a reactive approach, dealing with disruptions as they happen in real time.

'No system, no matter how optimised, can deal with all disruptions. Online planning ensures trains can be rerouted, rescheduled, or other action taken on the fly while minimising disruption across the rail network,' the Arrival coordinator says.

Although robust and online optimisation methods have previously been developed for other sectors, such as the aviation industry, they turned out to be inadequate when applied to railways due to the complexity and sheer size of rail networks. Whereas changing the take-off order of planes at an airport may cause notable disruption elsewhere, in a railway system, because trains have to use the same tracks, delaying the departure of one train can cause chaos across the network.

Dealing with such disruptions has traditionally been left to the experience of human planners, who have until now received little computer assistance.

'The only software used by most railway operators is graphics software that makes it easier for human planners to visualise what is going on and make their decisions. Our algorithms will not diminish the importance of human planners but they will help them find much more optimised solutions to problems,' Mr Zaroliagis says. 'Arrival success is based on the development of new concepts and methods that considerably advance the theory necessary to tackle such large and complex problems efficiently.'

In Berlin's U-Bahn underground network, where the Arrival algorithms are being used

commercially, they have resulted in the average waiting time between trains being reduced from four minutes to two minutes, while trials at Padua and Genoa train stations in Italy showed that the technology resulted in an average 25 % reduction in delays.

Hafas, the German company that provides itinerary information services for German rail operator Deutsche Bahn, has shown interest in the algorithms for use in its systems, while France's MediaMobile and Germany's PTV have bought them for use in mobile navigation services.

Mr Zaroliagis says the project's algorithms can find itineraries, not in seconds, but microseconds. In general, methods that could not be applied on the large scale required for railway applications have been so improved that they now not only work on the required scale but they do so efficiently, respecting of course the safety regulations set by rail companies.

This can mean the difference between chaos and potential accidents and a smooth contingency plan. It is no surprise, then, that the industry is paying attention.

'We have had a lot of interest from railway operators and firms in the transport industry, and some are implementing or planning to implement our algorithms,' he notes. The technology also has applications in other sectors.

'Our algorithms could benefit industrial work-flow systems, e-commerce, P2P and grid computing networks and even healthcare,' he explains. 'They could be used, for example, to optimise decisions about what type, dose and with what frequency to administer medications depending on how a patient's health is evolving.'

The project partners plan to explore those and other applications in subsequent projects, and Mr Zaroliagis says that they are open to ideas from outside investors and partners to take their work further.

The Arrival project received funding under the FET-Open research strand of the Sixth Framework Programme.

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(1) 'Algorithms for robust and on-line railway optimisation: Improving the validity and reliability of large-scale systems.'

Promoted through the ICT Results service.
http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91338

Innovative solutions to urban road freight transport

Road freight transport represents 77 % of total inland freight transport in the EU. And more than half of total goods transport in Europe is concentrated in Germany, Spain, France and Italy. With that traffic comes more pollution, more noise and a logistics nightmare. However, an EU-funded project has developed an innovative solution to coordinate and plan road freight transport.

Almost 80 % of total inland freight transport in the EU is delivered by truck or van. And it is set to increase, leading to more traffic congestion and CO_2 emissions. Already, one-third of all CO_2 emissions are attributed to freight transport. Everyone, especially city residents, is affected.

Mitigating the impact of urban freight transport in Europe by finding sustainable long-term solutions is vital. These solutions must be able to adapt to changing demographics, policies and technologies.

The logistics of road freight transport is a major challenge. How can one best coordinate the delivery of transport from point A to point B while taking into account traffic and road works across Europe?

The EU-funded project, MOSCA([1]), has developed software that enables users to coordinate freight transport by collaboratively involving private transport operators and local authorities dealing with traffic and road infrastructure. The three-project was co-financed by the European Commission.

'At the time, few were even talking about freight as a problem,' says Paola Cossu, MOSCA's project coordinator. 'It was the first time the idea of finding an integrated system to coordinate and plan freight transport was proposed. We then developed the MOSCA tool by having a user-oriented approach.'

Freight distribution has historically been severely hampered by a lack of integrated and coordinated tools between local authorities and private transport operators. The European Commission recognised the problem in a Communication on freight transport logistics action plan in 2007, which stated that Europe needs 'to mobilise untapped efficiencies in logistics in order to make more judicious and more effective use of transport operations'.

The MOSCA tool can help achieve that goal. It is currently being used in Germany, Italy, and Switzerland.

The central information system enables users to control five main services that are essential to improving efficiency. These services, or modules, are applied according to specific local needs. The services communicate with each other and external systems.

➔

The modules allow users to support dynamic planning and control of logistics operations, gauge impact of noise and pollution, proactively manage freight traffic transport, publish traffic network incidents and establish performance indicators of transport efficiency.

Integrating goods flows and their related infrastructure within urban transport models allows authorities to plan, assess and control freight policies according to their needs. At the same time, private transport operators are able to access traffic and road conditions.

'If you go from point A to point B, the route should be preferably "robust" in terms of reliability. So you need to find a suitable solution that is the most suitable and optimised to get to point B from point A on time,' says Ms Cossu.

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Bringing all these elements together into a user-friendly interface requires complex algorithms. These algorithms must, for instance, take into account stochastic travel times. Six of the eight modules are algorithms and are internal to the software. The other two modules act as user interfaces.

The internal algorithmic modules are MOSCA-freight, MOSCA-sustain, MOSCA-tour, MOSCA-line, MOSCA-short, and Relaxed CBA. MOSCA-freight calculates business traffic and freight transport demands of a city or region. Social costs and noise level emissions are calculated by MOSCA-sustain. MOSCA-tour optimises deliveries and helps reduce congestion. MOSCA-line re-routes vehicles in case of unexpected events such as new customer requests, traffic jams, and delays in delivery for instance. MOSCA-short is the algorithm that provides the shortest and the most robust path connecting two points. And the Relaxed CBA is an evaluation method that can find the best solutions to reduce noise levels.

MOSCA-shop and MOSCA-net are the interface modules. The MOSCA-shop is an open Internet platform where the user can integrate loading and unloading time. It also enables the vehicles to locate adequate parking space. MOSCA-shop is able to retrieve traffic related constraints from public systems and include them in the planning process at company level. And finally, MOSCA-net allows even the private consumer to take an active part and help influence the distribution of goods.

Frosinone, a mid-sized city in central region of southern Italy, is one of the most polluted in the country says Ms Cossu. Local authorities are experimenting with a follow up of the MOSCA project by applying a set of measures and investments to reduce traffic congestion. The follow up project, C Dispatch, is co-funded under the EU Life programme.

In a Europe where freight transport tends to grow slightly faster than the economy, where within 10 years freight transport has increased by 43 % alone — innovation and user-oriented designed tools are imperative. By targeting user needs and building its system architecture around those needs, MOSCA has demonstrated its capacity to tackle some of the most pressing problems of urban freight transport.

(1) 'Decision support system for integrated door-to-door delivery: planning and control in logistic chains'.

Created with the Transport Research Knowledge Centre and MOSCA
MOSCA was funded under the FP5 programme IST
(Use-friendly information society).
http://www.transport-research.info > projects & analysis > search > mosca

Coordinating photovoltaic research across Europe

A network of coordinators of national photovoltaic (PV) research and technical development programmes was established to improve the effectiveness and competitiveness of Europe's research effort. The network conducted a benchmarking study of different national and international programmes to determine the EU's ability to compete in the world market.

Europe is a leader in the field of photovoltaic solar energy, one of the most promising sources of renewable energy. In order to remain among the world's top three players in PV research, national programmes must be properly managed to identify opportunities and prevent duplication of activities.

With the support of European funding, the 'Network for coordination of European and national RTD programmes for photovoltaic solar energy' (PV-EC-NET) project supported a network of coordinators of national programmes from around the EU and included associated states. The project collected, assessed and disseminated information concerning PV national research programmes through its information network.

The consortium conducted a survey that benchmarked European research and development programmes against those of leading competitors such as Japan, the USA and Australia. Information on national research programmes was collected through the use of questionnaires and the results analysed by programme managers and experts from the PV-EC-NET project. The findings identified factors critical to the success and failure of research initiatives.

The information collated was used to assess the EU's position in the world PV market and help create a common European research strategy. The strategy will cover all aspects of PV research and development, including large-scale implementation and grid connection, as well as environmental issues such as life-cycle analysis (LCA).

Improving the coordination of research activities will help speed up the development and use of PV as a source of clean, renewable energy for the EU. This in turn will lead to the creation of new jobs, provide a welcome boost to Europe's economy and help protect the environment.

Funded under the FP5 programme EESD
(Energy, environmental and sustainable development).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5440

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Making waves in offshore structure design

As the search for new oil and gas fields continues, drilling is being conducted in deeper waters and an increasingly hostile environment. A European project developed risk-based methods for the design and safety assessment of floating structures that can operate under such challenging conditions.

Floating production, storage and offloading (FPSO) vessels are under development for processing and storing oil and gas from offshore platforms. The 'Reliability based structural design of FPSO systems' (Rebasdo) project provided advanced designs for safe and efficient FPSO structures, including hulls, moorings and riser systems. The major source of uncertainty when designing the new vessels comes from the environmental conditions they must face. Floating structures employed in offshore production are at the mercy of the weather and are most vulnerable when they must remain in the same position and cannot be moved to avoid a storm.

New probability models were developed by scientists and engineers to study the effect of waves, currents and wind on the FPSO units. Researchers were particularly interested in predicting the effects of wave crests and their impact on the floater and mooring systems. A statistical analysis of random waves was carried out by incorporating a second-order wave model into a spectral response surface method.

The new approach enables statistical data concerning wave crests to be calculated rapidly and accurately under realistic sea conditions. However, the technique does not cover all aspects of a wave's movement and underestimates the height of wave crests for unidirectional seas. These findings are based on short-term data and can be combined with long-term statistical information concerning storms and the number of extreme wave crests predicted.

Improved models can help predict extreme environmental effects that can lead to structural damage and serious economic consequences due to an interruption in production. Accurate simulations can be used to develop safety factors that can be applied to each stage of the design process of floating structures. Successful wave research can benefit shipyards and their engineers and designers as they adopt new safety rules and codes.

The new approach enables statistical data concerning wave crests to be calculated rapidly and accurately under realistic sea conditions.

Funded under the FP5 programme EESD
(Energy, environmental and sustainable development).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5450

Joining the dots to put pollution on the map

Air pollution monitors tell us a great deal about their immediate locations — and not much about the wider area. To fill the gaps on the map, European researchers have developed new statistical tools for a web-enabled world.

Imagine another nuclear accident like Chernobyl. Across Europe, measurements show increased radioactivity, but it's not yet clear how much has been released or where it is coming from. One measuring station reports high radiation levels, yet 30 km away, on the other side of a city, the readings are much lower. Should the authorities evacuate the city, and if so, where to?

European research in statistics has made it easier to answer questions like this, and many others relating to less dramatic forms of air and water pollution. By providing new ways to turn a set of point measurements into a contour map that can be published on the web in real time, scientists hope to make existing environmental data more useful, reliable and democratic.

All sorts of environmental issues, from nuclear and chemical spills to groundwater pollution and traffic fumes, involve decisions based on measurements taken at a relatively small number of points, notes Edzer Pebesma of the University of Münster, Germany. Air quality monitoring stations, for instance, have become a common sight in Europe, but the high cost of setting them up and running them will always limit their numbers.

So how do you find the value of an environmental variable at a point on the map where there is no monitoring instrument? Statisticians call this process interpolation. Starting with a fixed number of measurements taken in defined places, the challenge is to create a contour map that shows what is happening between the measurement points, and to say how accurate we can expect these contours to be.

Mr Pebesma heads the EU-funded 'Interoperability and automated mapping' (Intamap) project, which spent three years developing new statistical methods and software for interpolating environmental data. Though the mathematics involved is complex, the researchers took care to address real-world issues, Mr Pebesma says. For instance, depending on how much time is available, the software decides whether it can use the most accurate interpolation techniques or must settle for less sophisticated models that are quicker to calculate.

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Making the technology open and easy to use was reckoned so important that it took up a considerable part of the project's resources, Mr Pebesma says. The open-source interpolation software at the core of the project links to the outside world through web services. For instance, the system accepts raw data published on the web using open standards developed by the Open Geospatial Consortium (OGC). Once the numbers have been crunched, web services that also conform to OGC standards can create maps automatically, display them on the web and update them as needed.

Rating the accuracy of the maps was another big issue. Though statisticians are used to assessing the reliability of their predictions, the researchers found no existing way to convey this information in the context of web services. They therefore created UncertML, a new dialect of the XML document markup language, which looks set to become a standard for exchanging information about uncertainty.

The researchers put a lot of effort into convincing potential users that the project was worthwhile. Scientists responsible for radiation monitoring, for instance, are traditionally suspicious of interpolation, says Mr Pebesma — 'yet they still have to make difficult recommendations about whether and where to evacuate the city'. A measure of the project's success is that the German radiation protection authority (the Bundesamt für Strahlenschutz, or BfS), is now using the Intamap system to visualise hourly readings of gamma radiation provided by the European Radiological Data Exchange Platform (Eurdep).

Researchers whose job is to map urban and industrial air pollution — particulates and nitrogen oxides, for instance — have also seen the value of Intamap's automated approach. Mr Pebesma says the Intamap tools could also help the study of weather, groundwater pollution, agriculture, medical imaging and many other areas where a two-dimensional picture needs to be built up from a series of point readings.

The ability to create high-quality maps without needing to employ a statistician will help to make environmental data more useful and accessible, Mr Pebesma suggests. Levels of particulates, for instance, can vary a great deal between locations only a short distance apart, so someone who cycles to work could benefit from Intamap's ability to calculate their average exposure to pollutants and compare different routes. One of the project partners, Aston University, has already produced a mobile phone application which maps temperature from data provided by home weather stations.

Intamap has been highly rated by its reviewers. The project has built agreement among geostatisticians on which methods to use for interpolating different kinds of data and how to choose between them automatically, and enthused potential users about the value of interpolation. It has implemented complex statistical methods in a transparent way that allows their use by non-specialists, and given rise to several new research projects.

Intamap was funded under the ICT strand of the EU's Sixth Framework Programme for research.
Promoted through ICT Results service.
http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91275

Unlocking the secrets of flowering time

An EU-funded team of biologists has discovered that a single plant protein called Apetala1 (AP1) regulates over a thousand genes and helps create the tissues that go on to form its flowers.

The work was supported by the European Union through the project 'Trans-cis elements regulating key switches in plant development' (Transistors) which received EUR 2.11 million from the Marie Curie scheme under the Sixth Framework Programme (FP6). The results, which are published in the journal *Science*, could have enormous implications for the future of plant breeding and food production.

What is the mysterious process that makes plants burst into bloom? Most plants flower in the spring, but sometimes flowers can appear at unexpected times too. Scientists have long tried to discover the mechanism that gives plants the signal to begin creating a profusion of beautiful blossoms.

Now they are one step closer. An international research team, led by Plant Research International, part of Wageningen University in the Netherlands, carried out genome-wide microanalysis tests on *Arabidopsis thaliana*, a species of plant commonly known as mouse-ear cress, and discovered that the transcription factor protein AP1 is responsible for the plant's transition from green growth to the production of flowers by means of a series of complex molecular signals.

Transcription factors are responsible for switching a cell's genes on and off. Using gene expression profiling and binding studies at the beginning of the plant's flowering stage the team identified some of the factors that control the production of AP1 in *A. thaliana*. They found that AP1 acts primarily as a repressor during the earliest stages of flowering, holding back production of the green parts of the plant so it can focus on generating its flowers. It also helps to shape and design the flowers.

In addition, the team discovered that the protein regulates the initiation of the flowering period by integrating growth, patterning and hormonal pathways. They identified over 2 000 genes in *A. thaliana* that are possible AP1 targets based on their proximity to AP1 binding sites.

The research results could have enormous implications for the food production and plant breeding industries. If scientists can control a plant's growing and flowering cycle, then plant biologists can grow both new varieties of food crops and as well as plants and crops that can flower and fruit throughout the year, not just in spring and summer, thereby extending worldwide growing seasons.

The Marie Curie programme allows young scientists to take their own projects to a range of laboratories to receive expert scientific advice and training. The Transistor network brought together complementary technological expertise in a range of biological disciplines. Biology is becoming increasingly dependent on genomics, requiring biologists to become educated in bioinformatics. Transistor helped to converge biology and bioinformatics by training young biologists in genomics research and bioinformatics, thereby achieving critical mass in Europe between genetics, genomics and bioinformatics.

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 15933

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Measuring erosion in vital tidal habitats

Scottish scientists have developed a meter for measuring the erosion of tidal sediments. The sediments help defend the coastal environment from the sea and form a crucial habitat for wildlife.

Mudflats and tidal areas are highly productive ecosystems that can support large populations of wading birds and act as nurseries for young fish. They are also natural buffers, protecting the coastline from erosion by the sea. However, the tidal region is vulnerable to human activities, such as industry and urban development and potentially threatened by global climate change.

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The EU-funded 'Tidal inlets dynamics and environment' (TIDE) project was set up to help protect Europe's coastal wetlands and tidal environments such as saltmarshes, lagoons and estuaries. The work included the creation of computer models to provide greater insight into processes behind the erosion, distribution and transport of sediments.

Project partners St Andrews University, Scotland, developed the cohesive threshold meter (CSM). This device can quickly and easily measure the stability and erosion of intertidal deposits, which are exposed at low tide and covered by water at high tide.

The CSM included a water-filled chamber which is secured onto the surface of the sediment. A jet of a water erodes a small area of the sediment surface within the tank. The force used can be systematically increased with each jet of water for a given time period.

The level of erosion is determined by measuring the decrease in transmitted infrared light across the chamber as a result of suspended material. Data from erosion experiments is recorded onto the onboard central processing unit and downloaded onto a PC for further analysis at a later date. The results allow changes in sediment stability to be measured over time.

Findings by the researchers can be used to create better computer models of tidal areas. Improved simulations will enable more cost-efficient defences to be built for combating coastal erosion and contribute to improved management strategies for the coastal environment.

Funded under the FP5 programme EESD
(Energy, environmental and sustainable development).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5416

Grass can turn energy green

An EU-funded team of researchers has discovered that grass can be used to produce energy that doesn't harm the environment.

The team behind the discovery were working as part of the project 'Biomass, remediation, re-generation: reusing brownfield sites for renewable energy crops' (Bioregen), which received EUR 1.2 million under the EU's LIFE-Environment research programme.

Led by the Contaminated Land and Water Centre at Teesside University in the UK, the researchers aimed to show whether reusing brownfield sites to grow energy crops for renewable energy is possible. These abandoned or underused industrial or commercial properties are considered as potential sites for redevelopment.

The researchers kick-started the project in 2004 and found that *Phalaris arundinacea*, commonly known as 'reed canary grass', is a great candidate for growth on brownfield sites, and can be developed into fuel for biomass power stations and even boilers in school buildings.

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Reed canary grass a perennial grass widely distributed in Europe, North America, northern Africa and Asia. In the UK, reed canary grass is converted into bricks and pellets. Experts say that they are not harmful to the environment as they neither increase greenhouse gas emissions nor fuel global warming.

Besides reed canary grass, the researchers tested *Miscanthus* and switchgrass, as well as four plant types and willow trees, which are commonly used in biomass power stations, in various parts of the region.

'We have narrowed the plants down to reed canary grass because it grows so well on poor soils and contaminated industrial sites,' explained Dr Richard Lord, a reader in Environmental Geochemistry and Sustainability at Teesside University. 'That is significant because in areas like Teesside, and many similar ones around the country, there are a lot of marginal or brownfield sites on which reed canary grass can be grown,' he added.

'Selecting such sites means that the grass can be grown without taking away land which would otherwise be used in food production, a key concern for those involved in the biomass and biofuel sectors.'

Once the grass reaches maturity, a process that takes two years, it is harvested and baled up before its conversion into bricks and pellets.

'The test burnings have shown that reed canary grass produces a good, clean fuel without picking up contamination from the soil,' Dr Lord pointed out. 'Reed canary grass has great potential because it offers a suitable use for unsightly brownfield sites while producing an excellent fuel at a time when the world is crying out for new ways of producing green energy,' he went on to say.

'Our research also suggests that the end product is improved soil quality and biodiversity at the greened-up sites. We are now examining ways in which we can commercialise this idea and are already talking to a number of major biomass power station operators.'

Experts say crops burnt specifically for fuel falls under the 'renewable energy' category. Carbon dioxide (CO_2) is released into the atmosphere when the biomass is burnt. When crops are re-grown, the same amount of CO_2 is removed from the atmosphere. Biofuels are considered carbon neutral because they have no impact on the CO_2 levels in the atmosphere.

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 15253

Frost flowers and the loss of Antarctic ozone

Climate chemists studied the Antarctic region to help understand the role of frost flowers and sea salt in the degradation of ozone in the troposphere.

Water vapour settling on newly-formed sea ice can produce a phenomenon known as frost flowers, which has been linked to the loss of ozone during the polar sunrise. A study into frost flowers was conducted as part of the 'Tropospheric halogens - effect on ozone' (Thaloz) project, which investigated the effect of reactive halogens, such as bromine, on ozone contained in the troposphere. The troposphere contains most of the atmosphere's water vapour and airborne particles, known as aerosols and is the part closest to the Earth's surface.

Researchers found that frost flowers are the main source of sea salt aerosols in the Antarctic and contain three times more salt ions than seawater. The high salt concentration and large surface area of the frost flower enables the efficient release of chemicals into the atmosphere. The salt-laden surface of the ice catalyses reactions, in a process known as a 'bromine explosion'.

Polar scientists used satellite-based sensors to measure the level of the ozone-depleting compound bromine monoxide (BrO) and sea ice coverage. The resulting computer model indicated that young areas of sea ice containing frost flowers seem to be the most likely source of bromine for bromine explosion events. The models were used for analysing the regional and global distribution of halogens and their effects on the troposphere and climate chemistry.

The Thaloz project will enable scientists gain a greater understanding of how salts are transported from the ocean to become airborne reactive halogen species. The project's findings provided valuable information concerning the role of reactive halogens in the troposphere and the chemical processes that control them.

Funded under the FP5 programme EESD
(Energy, environmental and sustainable development).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5432

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Improving carbon estimates for Europe's forests

Carbon stocks in European forests were determined by estimating changes in tree biomass and soil carbon. The results were used to develop better systems for helping the European Union to comply with the Kyoto Protocol.

Scientists from the Carbo-invent(1) consortium used statistical data from national and regional forests to determine biomass for entire trees. Together with carbon estimates from soil studies, this information was used to calculate forest carbon stock changes at national and European level. The project was part of the EU's commitment to the United Nations Framework Convention on Climate Change (UNCCC), enabling targets set by the Kyoto Protocol to be met.

A forest resource projection model was used to calculate carbon budgets for large-scale forests in six EU countries — Germany, Spain, Ireland, Austria, Finland and Sweden. Biomass carbon was estimated for different tree species and age classes from volume measurements. Biomass expansion factors (BEFs), ratios refined within the project, were used for the conversion. Differences in the levels of carbon per hectare in the test countries could then be compared to the average biomass per hectare.

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Researchers assumed that the area of forest did not alter during the study period and any changes in carbon stocks were due to the death or ageing of the trees. However, the number of trees felled depended on a range of factors including market prices, demand for wood and storm damage. As a result changes in tree biomass found in the computer model may differ from what actually occurs.

The forestry model was also used to estimate the amount of leaf litter in the soil and the results applied to a soil carbon model, YASSO, which simulates litter decomposition. National soil carbon estimates for Germany, Austria, Finland and Sweden were found to be lower than values obtained from the model. However, Irish and Spanish soil carbon estimates were found to be higher than in the simulation. The differences could be due to an overestimation of decomposition rates in organic soil and past changes in forestry management and environmental conditions.

The Carbo-invent approach enabled different data sources to be used, giving a better estimation of carbon stock changes in forests throughout Europe. The result was the development of more accurate national forest inventories which can provide more effective reporting of greenhouse gas emissions.

(1) 'Multi-source inventory methods for quantifying carbon stocks and stock changes in European forests.'

Funded under the FP5 programme EESD (Energy, environmental and sustainable development).
Collaboration sought: further research or development support.
http://cordis.europa.eu/marketplace > search > offers > 5427

Giant hogweed bites the dust

An aggressive toxic invader, the giant hogweed, is taking over the European landscape. But help is at hand in the form of an EU-funded research project that is investigating ways of controlling and eradicating it.

Reaching five metres in height, the giant hogweed (*Heracleum mantegazzianum*), produces toxic sap that can cause skin blistering and even blindness. It also outgrows and displaces native plants, damaging ecosystems and reducing the number of species they support. The invasive weed was originally introduced into European gardens as an ornamental plant in the 19th century and can now be found colonising waste land across the EU.

The 'Giant alien'(1) project was set up to combat giant hogweed by developing an environmentally safe management strategy for controlling its spread. Emphasis was placed on developing sustainable strategies, perhaps making use of biological control methods and its natural competitors and enemies.

Understanding the weed's biology and how it reproduces is crucial to successfully limiting or eradicating it. Researchers therefore investigated factors affecting the plant's ecology, biology, population characteristics and growth cycle. Botanical studies conducted in the Czech Republic and Germany showed that giant hogweed has a high seedling density and experiences low plant mortality combined with rapid population growth.

Giant hogweed originally comes from the Caucasus where it favours, and is normally limited to, habitats disturbed by human activity. It can successfully self-pollinate and produces thousands of viable seeds which are then dispersed by wind, on the tyres of vehicles or attached to clothing or animal fur. The seedlings germinate in early spring before native species appear and rapidly increase in size and number, covering other species in dense shade winning the competition for light.

Project partners developed best practice guidelines for local authorities and private landowners to control not only giant hogweed, but invasive alien weeds in general. The guidelines enable the weed to be identified and successfully eradicated, while preventing similar looking native plants from being misidentified and destroyed in error.

Control of giant hogweed and other invasive plants protects vulnerable ecosystems and conserves native plant and animal species. The work of 'Giant alien' will also help prevent injuries caused by contact with toxins produced by the weed.

(1) 'Giant hogweed (*heracleum mantegazzianum*) a pernicious invasive weed: developing a sustainable strategy for alien invasive plant management in Europe.'

Funded under the FP5 programme EESD (Energy, environmental and sustainable development).
Collaboration sought: further research or development support.
http://cordis.europa.eu/marketplace > search > offers > 5426

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Measuring mixtures of oestrogenic compounds

An innovative European project has investigated the effect of mixtures of oestrogenic compounds on biological systems. The study will help scientists gain a better understanding of the risks these chemicals pose to both the environment and the human population.

Concern is growing about the effect on aquatic life from chemicals that mimic the female hormone oestrogen. One problem associated with these compounds is disruption to the reproductive system of a number of fish species. Most scientific research has until now focused on the effects produced by a single chemical. However, identifying the cause of effects found in aquatic organisms requires an understanding of how suspected causative agents might act when present as a mixture.

The ACE ([1]) project investigated the impact caused by combinations of oestrogenic chemicals. This approach more accurately reflects what occurs in the real world than studying single compounds. The consortium's multidisciplinary research team included fish biologists, endocrinologists, statisticians and analytical chemists.

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Project partners VU University Amsterdam used the 'Estrogen responsive chemical activated luciferase gene expression' (ER-CALUX) assay to test the combinative effects of 13 oestrogenic compounds on a human breast cancer cell line. The compounds were first tested individually to determine their effect at different concentrations. Mixtures of these oestrogen mimics in ratios based on these levels were then used in the assay.

Significant mixture effects could be identified even when every compound present was at a concentration that would not have a significant effect if applied on its own. The ER-CALUX assay was extremely sensitive and provided results that could be easily reproduced, even for mixtures made up of many components.

Findings by the ACE project suggested that in some circumstances it was possible to predict the effects produced by a mixture of compounds accurately. This information can help contribute to the creation of more effective environmental standards for protecting the aquatic environment and the general public.

(1) 'Analysing combination effects of mixtures of estrogenic chemicals in marine and freshwater organisms.'

Funded under the FP5 programme EESD (Energy, environmental and sustainable development).
Collaboration sought: further research or development support.
http://cordis.europa.eu/marketplace > search > offers > 5443

Damage limitation for historic tapestries

Tapestries woven between the 15th to the 18th centuries are an irreplaceable part of Europe's cultural heritage. An EU-funded project evaluated the best techniques for providing vital information for the conservation of these historic artefacts.

Funded under the FP5 programme EESD (Energy, environmental and sustainable development).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5435

The 'Monitoring of damage to historic tapestries' (MODHT) project involved experts in the fields of conservation science and textile and analytical chemistry. Researchers employed traditional techniques to produce model tapestries for use as scientific standards. The standards were used to develop physical and chemical markers for characterising fibres, dyes and metal threads.

Analysis was undertaken on the microscale, linking chemical composition with the strength of the tapestry's fibres. Changes at the molecular level can identify the state of the fibre and a tapestry's overall strength, before any damage becomes visible. Microanalysis of products from the breakdown of dyes and mordants, used for fixing dyes, can also provide valuable information for researchers.

Conventional acid extraction techniques for removing dyes from wool and silk fibres could not be used as they can interfere with the analytical process. Project partners from the University of Edinburgh used two-dimensional nuclear magnetic resonance (2D NMR) and liquid chromatography-mass spectrometry (LC-MS) techniques to identify suitable marker compounds.

The marker was found to be dyed with logwood following the extraction of tapestry fibres. Furthermore, LC-MS analysis identified a marker in fibres dyed with brazil wood. Both logwood and brazilwood are tropical trees from Central and South America that provide natural sources for dyes.

Work undertaken by the MODHT project enables museum curators to have a better understanding of the condition of tapestries in their care. With this information they can make more informed decisions about preserving these unique cultural treasures.

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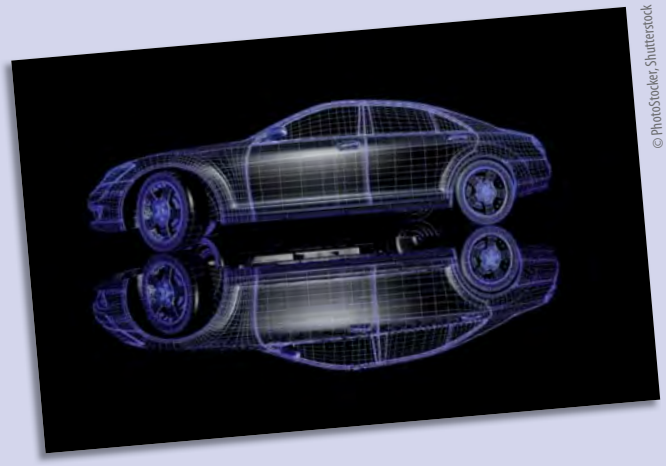
Embedded electronics — cars get cooperative

European researchers have developed a groundbreaking middleware platform that could lead to thousands of new applications in a range of industries. Beginning with in-car electronics, the platform can access the functionality, but hide the underlying complexity, of embedded sensors, making development and deployment of new services a snap.



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Modern devices and appliances are literally riddled with embedded sensors, from the relatively simple devices that make your microwave turn off, to the electronics that control the braking in your car.

These systems are often designed for a specific task, but their functionality — sensing a sudden deceleration for example — could be used in other ways, and in cooperation with other sensors, to create totally new applications.

There is a problem, however. Embedded sensors are complicated, and difficult to access and control.

Now European researchers in the project 'Embedded Middleware in mobility applications' (EMMA) have developed a new middleware platform, called EM2P, that takes the difficultly out of developing new applications for existing embedded sensors. It acts as an interface between designers and the electronics.

'We sought to hide the underlying complexity of in-car embedded sensors so that developers could quickly design new applications with existing electronics,' explains Antonio Marqués Moreno, coordinator of the EMMA project. 'EMMA will foster cost-efficient ambient intelligence systems with optimal performance, high reliability, reduced time-to-market and faster deployment.'

The project hopes that, by hiding the complexity of the underlying infrastructure, its work will open up new prospects in the field of embedded, cooperating wireless objects. It aims is to provide open interfaces to third parties. But its work goes further, into hardware, to develop a robust wireless communication interface to link various sensors together.

Transport is a useful but challenging test case, and the EMMA project focused on this area for its work. There are many opportunities to enhance road safety, for example, by communicating between sensors within a car, and with other cars or street signs. There is a range of potential applications with logistics, too.

'One of the particular strengths of EM2P is its scalability,' says Mr Marqués. 'It only worked with one car, but it has been designed to be able to work with an entire city's vehicle population, which offers enormous opportunities for traffic management and many other areas.'

One of the key advantages of the EM2P platform is that it works on a concept of cooperating objects, so it is able to communicate at very different levels within a traffic system using the same level of abstraction.

So it can work in-car, where FIAT used EM2P to study the potential for a system that senses the performance of each engine cylinder and gives the driver a real-time update on engine performance.

But it could also work between cars — opening the prospect of cooperating cars — and, of course, it can work with traffic infrastructure like lights, warning signs, and other signalling information. All of this via the same middleware platform.

Moreover, EM2P is able to support different physical communication technologies, which allows for interoperability and greater flexibility of applications. So even if the project's wireless hardware does not become standard, the platform is still relevant.

The EU-funded EMMA project set out to develop proof-of-concept demonstrators to show that the middleware works. 'We were not trying to build a commercial application, but rather show that the system worked,' notes Mr Marqués.

And it worked very well. 'Though, you know how these things progress: the first time there were problems, but the second time it worked fine,' he adds. The City of London traffic management team offered to help.

A modified car, equipped with EMMA's wireless system, informed London's traffic infrastructure of any obstacles sensed by the car's radar. This sounds, perhaps, unremarkable, but it shows that the tools now exist to easily design new applications from existing embedded electronics, and apart from the host of applications it offers in traffic management, it could also be applied to any embedded electronics system.

'We wanted to facilitate the design and implementation of embedded software,' says Mr Marqués. 'EM2P was designed to be used with any embedded electronics, but for our test case scenario we looked at embedded software for cooperative sensing in the transport domain.'

The project is also part of a broader effort to develop wireless 'cooperating objects', and EMMA's work contributes to research in the European CONET network. EMMA will, itself, continue working in a project, called PECES, where it will further refine the EM2P concept.

It all means that, finally, embedded electronics will get uncomplicated.

The EMMA 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=90703

Complex software systems — heal thyself

Software underlies modern life, keeping everything from mobile phone networks functioning to planes in the air, but ensuring increasingly complex systems stay free of faults has become an epic task. What if software could heal itself?

Researchers from Israel and six EU countries have carried out pioneering work on self-healing software capable of automatically and autonomously detecting, identifying and fixing errors in the copious lines of code that make up complex systems. The results of their research are already being used internally by several companies and could feed into commercial products in the near future.

'Software systems have grown increasingly large and complex as we come to rely on them to do more things. Just making a single mobile phone call may involve hundreds of systems operating behind the scenes and all of them need to work properly,' notes Onn Shehory, a researcher at IBM in Haifa, Israel.

We are talking about hundreds of systems containing hundreds of thousands or even millions of lines of code. And if just a tiny part of that code is wrong — due to design flaws or faults introduced while in use — performance will be degraded or the system may not function at all. Fixing software faults has, until now, meant calling on software engineers to sift through the code to identify the cause, locate it and repair it, a process that could be compared to searching for a needle in a digital haystack.

Tools developed by a team of researchers, coordinated by Shehory and funded by the European Union in the project 'A self-healing approach to designing complex Software Systems' (Shadows), do the sifting, identifying and fixing automatically. The approach relies on a set of detection-localisation-healing-assurance loops that function in the background of complex software systems, without the need for human intervention.

The detection stage reveals or predicts the presence of problems, such as functional deviations, performance bottlenecks or concurrency problems. The localisation stage identifies the fault that caused the issue. The healing stage provides automatic or semi-automatic problem remediation. And, finally, the assurance stage examines the healing that has been done to ensure it solved the problem and no new problems were introduced.

A unified framework, based on open standards, such as Eclipse, provides a single methodology and architecture.

'Say you have several hundred thousand lines of code. We don't analyse all of it but instead look at those areas — perhaps 10 000 lines — that have been identified as being at greater risk of faults. Monitoring it all would be too costly as the load on the system from the healing software would be greater than from the software that is being monitored,' Mr Shehory explains.

When a fault is detected and its cause found, the tools can automatically apply a series of predefined solutions until it is resolved. In addition, the tools can be used to generate a model describing how a software system should function in a set of typical scenarios. These models can then be used to make comparisons with how it is functioning in reality.

'This is particularly useful when comparing different versions of the same software,' Mr Shehory says.

By using aspect-oriented development, the researchers designed their tools to function with legacy systems, ensuring that companies do not have to 'reinvent the wheel' and redesign their existing software in order to incorporate self-healing features. This makes the Shadows tools cost-effective and relatively simple to implement.

The team also worked on tools and drew up guidelines for developers creating new software, to encourage the development of software for complex systems with built-in self-healing capabilities.

'It will take time for this to be widely accepted by developers as they have to be able to trust tools that are going to act autonomously,' Mr Shehory notes. 'Yet, results already achieved by project partners using the Shadows technologies demonstrate that risks due to autonomy are well contained.'

Companies have already started applying the tools with success, with one telecommunications firm having used the Shadows approach to identify and correct a long-running fault in its call servers.

'There is a very real need for self-healing solutions among users of software… although I think the biggest initial demand is from software developers who want to reduce software testing times,' Mr Shehory explains.

'They tell us that if our tools can reduce the time it takes to test for bugs and errors by just a few weeks it would be a major advantage.' Several of the project partners are continuing to work together, and a follow-up project is planned with that goal in mind.

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

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http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91267

Space-time continuum for mobile networks

The days of mobile signals fading out and vast coverage black spots are a thing of the past for most Europeans, thanks to pioneering European research efforts to boost wireless network coverage across the continent.

Only a decade ago, the classic thriller featured a victim struggling to get a signal as an attacker drew ever-nearer. That sort of suspense film would push the realms of believability in Europe today due to unprecedented improvements in mobile networks.

Part of the credit for this evolution goes to a series of European research projects working in the rather less Hollywood-sounding area of terrestrial wireless systems and networks. Nonetheless, these are paving the way towards better and better mobile internet.

In this field, a consortium of researchers from Spain, France and Austria stands out. Working in the project 'Advanced network radio identification for universal mobile communications' (Antium), the scientists have studied optimal signal processing algorithms for a network-monitoring device that they developed. The new system helps operators of UMTS/TDD cellular communications systems to monitor and improve their network.

UMTS/TDD is a universal mobile telecommunications system using time-divided duplexing. It is one of a number of mobile internet-access systems, along with WIMAX and Hiperman, which provide broadband speed access to the internet. Experts believe UMTS/TDD has the advantages of being able to use an operator's existing UMTS/GSM infrastructure as well as performing more consistently.

Antium applied what it calls 'interference analysis' to the problem — using multiple antennas and sophisticated multi-user, space-time signal processing algorithms estimating the interference levels of many surrounding base stations (including base stations with weak power).

The signal-processing algorithms concern the stages of synchronisation, channel estimation, and data detection. The overall goal is to demodulate (extract the signal from the carrier wave) the system information transmitted on the broadcast channels of the different base stations.

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Antium's key innovation was to adapt and extend advanced signal processing techniques (e.g. MMSE filtering, GLRT hypothesis testing, DFB detection) to the special demands of network monitoring in UMTS/TDD, exploiting the availability of multiple receiver antennas in an off-line signal processing mode.

The performance of Antium's algorithms has been tested in simulations using the computing environment Matlab. Results have also been published in conference papers, an industry journal and a doctoral dissertation.

Europe may also have Antium and related research to thank for putting an end to the tiresome mobile-phone suspense thrillers of the last decade.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: further research and development support.
http://cordis.europa.eu/marketplace > search > offers > 5444

A whole new world for the visually impaired

Through the use of a joystick interface, visually impaired people can access technical diagrams. This opens up a huge range of leisure and work opportunities that would otherwise remain closed.

Digitised technical drawings are used in education as well as at work and at home. With the right software, sighted individuals can work with digitised images on standard PCs. Such images however were previously inaccessible for blind or partially sighted persons.


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The EU-funded 'Technical drawings understanding for the blind' (TEDUB) project worked to overcome this obstacle by transforming visual information in technical drawings into a format that can be used by the visually impaired. The information is extracted through image-processing followed by a close analysis of the function of the information.

What is extracted can be verbally interpreted so that the user can tailor the functions according to individual needs thanks to an interface. Examples of domains which can be navigated include architectural floor plans, circuit diagrams and 'Unified modeling language' (UML) diagrams. The interface, in this case a joystick, provides a spatial interpretation of how the content is represented and interrelates.

Applications for this technology are far-reaching as data is represented in many different formats. These include standard pointed (scatter) diagrams and box graphs.

The system opens up independent access to graphic material for blind people. Grasping the spatial layout of content helps visually impaired users communicate with sighted people using the same diagrams levelling the playing field in employment, leisure and education.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: further research or development support.
http://cordis.europa.eu/marketplace > search > offers > 5441

Bond-style tech for emergencies

Instantly deployable James Bond-style information and communication technologies are now available to coordinate disaster response among diverse agencies and NGOs, thanks to European researchers.

Emergency crews approach a badly damaged building. The earthquake that struck four hours before left the town destroyed, but many people remain to be found. Eight different agencies are now on site, desperately trying to coordinate efforts to rescue survivors in the twisted landscape.

The team leader consults his PDA, linked via peer-to-peer (P2P) technology to dozens of databases with relevant information. According to the latest census, 10 people normally live in the building. The operator is provided with the names and ages.

According to telephone records, two other people were in the building 10 minutes before the earthquake struck. When the operator arrives at the rescue location, a city engineer is already running up, sent by the P2P-powered central dispatch.

The engineer declares the building safe to search, and the team enters. As victims are found central dispatch is updated on their condition, and doctors are standing by. The team leader and central dispatch keeps track of the searchers through geo-tagging, which provides a live update of the team-members' location in the building.

In 10 minutes, 9 people are rescued, 1 body is discovered, and the searchers learn from a conscious survivor that two people were away during the quake. The names of the absent are noted and sent to central dispatch, who can alert them on the status of their home and its occupants.

This is fiction, but it illustrates the coming paradigm for emergency response. Thanks to the work of European researchers at the Workpad(1) project, special-ops style information and communication technologies will be available for instant deployment, easily tied to the databases of diverse emergency agencies and civil authorities, ready to make disaster rescue more safe and effective.

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It was a tough problem, or rather many tough problems. Emergency response agencies, civil authorities and the NGOs who typically participate in disaster rescue and relief usually use different back-office systems, so they must be linked together. Then a network must be in place to link the back-office to the front line, where operators mostly use PDAs.

In all, the Workpad project worked on five allied major problems and dozens of minor ones. First, they developed a reference architecture, an overall scheme illustrating the most effective way of providing these diverse needs. That reference was a huge success for the project, receiving plaudits from the IEEE, a technology association, and now influencing 'emergency internet' standards at the W3C.

Next, Workpad developed a peer-to-peer data integration system on the back end. It is responsible, for example, for pulling together phone records, electoral registries, maps and geo-referencing, among dozens of other potential sources of useful information.

The project then moved onto large-scale collaboration and workflow in a mobile environment, a crucial piece of software that can define tasks, assign roles, and provide step-by-step instructions to the frontline. And it can be updated in real time, so if a more urgent need arises, workers can be interrupted to tackle another task.

The consortium also focused on the use of geo-referenced information to show a team-leader, for example, the location of all his or her team members.

'We started this project with a set of research ideas, technologies we thought would be useful,' explains Massimo Mecella, assistant professor at Sapienza University of Rome and technical manager of the Workpad project. 'But we very quickly sought to get new ideas from the frontline operators. We wanted to deal with real problems, rather than solving problems we thought were important.'

Geo-referencing rescue operators was one of the refinements that came from user needs, allowing leaders to know where people are at any time.

Finally, the project looked at a variety of communication technologies to ensure the system could be set up and transmit in a matter of hours, and that it can adapt to the most appropriate available technology at any site.

The system underwent a test in southern Italy, and performed with flying colours, receiving the enthusiastic endorsement of veteran emergency teams. Workpad's peers, in academia and elsewhere, have been enthusiastic, and the team produced over 90 journal and conference papers on their work.

But there is more work to be done, and the Workpad team has been encouraged to seek further funding under the European Union's Seventh Framework Programme for research.

'There is a lot of work we did, and we could do a lot more. For example, the system records all the actions undertaken by various teams, and how the entire operation progresses,' notes Mr Mecella.

'While the system already records, we could develop software to analyse how an intervention progressed, and perhaps do some data mining to find better, more effective ways to respond to an emergency in the future.'

There are other similarly interesting questions the partners could explore, such as using sensors with frontline workers, PDAs with team leaders and even using independent environmental sensors dropped across the disaster zone.

But the technology developed by Workpad is ready for use in the real world now, and may do so soon. Currently, a proposal for deployment in the Calabria region of Italy is under consideration. Calabria is a good candidate, because it suffers every year from both flooding and fires, which require frequent emergency response. 'The plan would see 1 500 PDAs deployed among emergency workers,' notes Mr Mecella. Authorities in the Czech Republic, too, are considering deployment.

In all, it is an impressive list of achievements for a relatively small project, with a budget of just EUR 3.16 million, EUR 1.85 million provided by the EU. And it will mean technology helping frontline disaster workers to save lives.

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

(1) 'An adaptive peer-to-peer software Infrastructure for supporting collaborative work of human operators in emergency and disaster scenarios.'

Promoted through the ICT Results service.
http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91287

Artificial nose gives as good as it gets

Is smell a personal sense, one that is specific to culture? No, says an Israeli team of scientists who have successfully 'trained' an electronic system capable of predicting the pleasantness of new odours.

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Their study, presented in the journal *Public Library of Science (PLoS) Computational Biology*, was supported by the EU through a Seventh Framework Programme (FP7) grant from the European Research Council (ERC). The results could potentially lead to new methods for odour screening and environmental monitoring.

The last 10 years have seen rapid developments in the technology of artificial noses, or eNoses as they are also known. These electronic devices can detect and recognise odours thanks to chemical sensors that are 'housed' inside noses. One of the objectives of artificial nose technology is to report perceptual qualities of new odours.

In this latest study, the scientists from the Weizmann Institute of Science and the Edith Wolfson Medical Center, both based in Israel, contend that the perception of an odour's pleasantness is naturally hard-wired to its molecular structure. Personal or cultural differences are evident only within specific contexts, they said.

For the purposes of their research, the scientists tuned an eNose to human odour pleasantness estimates, and then used the device to predict the pleasantness of new odours. The team asked native Israelis to rate a selection of odours on a scale from 1 to 30, ranging from 'very pleasant' to 'very unpleasant'. The team used the results of these tests to develop an 'odour pleasantness' algorithm that they programmed into the eNose.

The team then used the newly-programmed eNose to rate a number of unfamiliar odours. To find out whether the eNose's understanding of what smells nice chimes with the human nose's opinion, the team got a second group of Israelis (who had not been involved in the first part of the experiment) to rate these new smells.

The scientists found that their device's ratings of odour pleasantness were over 80 % similar to the humans' ratings. The eNose's ratings were also more than 90 % accurate at discriminating between categorically pleasant or unpleasant odours.

But does our culture influence our opinions of what smells good? To find out, the team tested eNose predictions against a group of Ethiopians who had recently emigrated to Israel. The scientists found that the eNose was able to predict Ethiopians' opinions of a new smell, even though it was 'tuned' to the pleasantness of odours as perceived by native Israelis. According to the team, this suggests a cross-cultural similarity in odorant pleasantness.

'Culture influences the perception of olfactory pleasantness mostly in particular contexts,' explained Professor Noam Sobel from the Department of Neurobiology at the Weizmann Institute of Science. 'To stress this point, many may wonder how the French can like the smell of their cheese, when most find the smell quite repulsive. We believe that it is not that the French think the smell is pleasant per se, they merely think it is a sign of good cheese. However, if the smell was presented out of context in a jar, then the French would probably rate the odour just as unpleasant as anyone else would; that is why the French don't make cheese-smelling perfume.'

The scientists said that the molecular features of an odour stimulate the eNose's chemical sensors, triggering a unique electrical pattern — what the team calls something like an 'odour fingerprint' — that characterises the specific smell.

The eNose must be 'trained' with odour samples in order to build a reference database, according to the researchers. Where human noses and the eNose differ is that the former can recognise and even classify a novel odour whose fingerprint is not available in the database.

The Israeli team's innovation was to train the eNose to predict whether an odour would be perceived as pleasant or unpleasant, or even something in between. 'The uniqueness of this approach was that rather than learning singular odorant objects such as "rose" or "skunk", their eNose learned an axis, and could then place novel objects anywhere along the axis it learned,' the researchers explained.

'These findings suggest that unlike in vision and audition, in olfaction there is a systematic predictable link between stimulus structure and stimulus pleasantness,' the authors of the study wrote. 'This goes in contrast to the popular notion that odorant pleasantness is completely subjective, and may provide a new method for odour screening and environmental monitoring, as well as a critical building block for digital transmission of smell.'

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 16133

Re-learning how to help professionals share their practice

Online tools developed in Europe have created completely new approaches in pedagogy — the science of education.

A student taking an oral examination can be filmed and their performance 'marked' with written, sound or visual comments using a multimedia tool called LimSee3. The resulting multimedia document can be shared so that other teachers and examiners can develop consistent approaches to marking.

This innovative tool is just one of a series developed during the Europe-wide Palette([1]) project to help 'communities of practice', such as teachers. Communities of practice are disparate groups of people — usually professionals — who strive to define, shape, share and manage a body of knowledge.

'There are many online collaboration tools, but most of them are oriented towards enterprises, not communities,' explains Christine Vanoirbeek who coordinated the researchers in Palette.

The semantic web plays an important role here. It is about more intelligent web-searching. It enables web searches based on interlinked concepts rather than simply searching for strings of letters.

Behind the semantic web are 'ontologies', databases of linked and searchable

➔

concepts. These webs of linked concepts rapidly become complex and are difficult to maintain and develop. One of the objectives of Palette was to get communities of practice to build up their own ontologies as part of the development of their subject area.

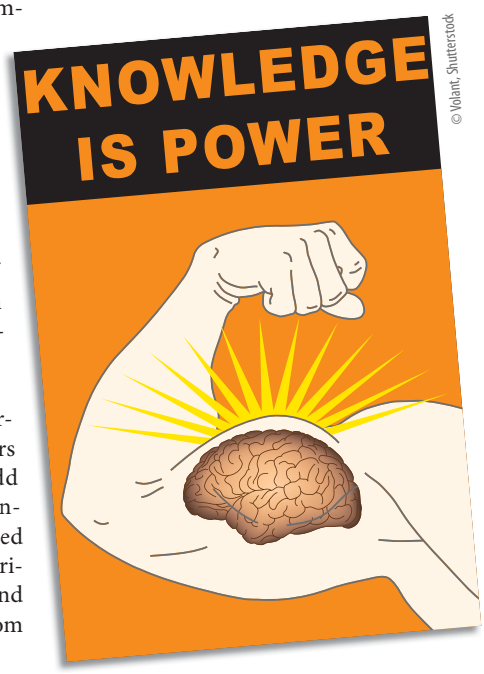
Many of the Palette tools exploit the advantages of Web 2.0 social networking technologies or the powerful document-searching capabilities of the semantic web. For instance, Ms Vanoirbeek and her colleagues on the EU-funded project worked on ways to ease document-sharing across the internet by eliminating the need to exchange emails or open a series of applications during a collaboration.

The eLogbook Web 2.0 social software is a tool for collaboration and learning in communities of practice. eLogbook offers community members a networking and communication platform, a repository for sharing and managing resources, a task and activity management system, as well as a community structuring tool allowing the definition of roles and distribution of tasks. eLogbook also provides different types of notifications (via email, or RSS feeds) in order to motivate contribution and sustain collaboration.

Palette's CoPe_it! tool creates online personal or collaborative workspaces. Users can share ideas and comments or add multimedia documents. The created content can be shifted about and reorganised by the users — even users with little experience. The idea is to enable discussion and collaboration, creating something new from collaboration within the workspace.

Another tool, Sweet-Wiki combines the easy interaction of a wiki with the power of the semantic web. A wiki is a website which makes creating and editing any number of interlinked web pages via a web browser much easier.

'The big challenge in the Palette project was to make these tools interoperable, so that the tools could be combined and information reused,' explains Ms Vanoirbeek. 'In fact, the goal of Palette was twofold, to imagine and develop new tools, and then to observe the manner in which provision of those new tools affected the way communities of practice worked.' That required the adoption of standards to which all tools would conform in order to achieve full interoperability.



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Palette also developed a Service Portal, distributed under the name myWiWall. The portal comprises multiple widgets giving access to different Palette services available to a community of practice from a web-browser window.

The content of a Palette widget is a 'summarised' version of a Palette service. Widgets permit some functions of services to be fully or partially executed by the end-users. When they wish to use more sophisticated features, they can launch the full version of the services in a totally transparent manner.

A wide collection of widgets is already available, ranging from simple clocks and notepads, to more complex services such as RSS feed readers, shared schedules or semantic Wiki search engines.

The power of the Palette project, and its success, came through the cross-disciplinary nature of the groups working on it, from IT researchers to education specialists.

'Beyond the technical and IT developments that the Palette services represent, there was substantial work performed by the pedagogical researchers in terms of learning approaches for a community of practice,' points out Ms Vanoirbeek.

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

(1) 'Pedagogically sustained adaptive learning through the exploitation of tacit and explicit knowledge.'

Promoted through the ICT Results service.
http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91279

Out with print outs, in with intelligent documents

In the future, users will be able to ask questions about the information they see on the screen of their computer and receive a relevant answer immediately. The idea behind 'active documents' may sound like science fiction, but the partners in a European project think it's possible.

The majority of web users are familiar with books, newspapers, or tax declarations. 'Active documents' promise to enhance these static documents with state-of-the-art software technology, pushing away the boundaries and limitations of traditional media.

Web entities such as extensible markup language (XML) data and pieces of software will be combined in 'active documents' that could replace conventional documents, browsers and even complete applications.

Similar to standard software products, they will need to be composed of smaller software components.

Programmers do not want to develop their programs over and over again, but to reuse already existing parts in new applications. They need to be productive and quicker than the competitor. An appropriate reuse technology means that components can be bought in web shops and later composed with powerful composition operators.

The goal of the EU-funded 'Easy composition in future generation component systems' (Easycomp) project was to develop the foundation of such a composition technology. Second-generation component technologies like Java and .NET provided a huge range of general-purpose components ready to be reused, putting the development efforts on a firm footing of well-tested building blocks.

Nonetheless, source code adaptations are necessary when composing independently developed components that do not fit each other exactly. This is why the Easycomp project partners developed the Composition (Compost) system.

The Compost system bridges interaction mismatches among software components, by invasively modifying them using automated program transformations. More

specifically, it includes a library of common transformations in the form of Java 'meta' programs, which can also be the generator of glue codes.

The sophisticated source code analyses support the active document evolution as the requirements of end-users change. Still, configuration and tailoring is based on easy composition operations, paving the way for next generation software systems which are profoundly user adaptive.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5442

Security founded on trust

Human interactions are often based on mutual trust, so why shouldn't those of machines? One European project has developed a system through which mobile devices can evaluate the trustworthiness of computer networks.

Trust is an important concept underpinning society. Without it, human interactions would become cumbersome and perhaps even impossible. The application of trust leads naturally to a decentralised approach to security management that can tolerate partial information, albeit one in which there is an inherent element of risk for the trusting entity.

We are moving towards the time when there are more things linked by the internet than people. The complexity involved in enabling potentially billions of individual devices to communicate with one another means a decentralised approach will become essential if security systems are not to become unmanageable.

However, basing electronic interactions on trust requires not only a thorough understanding of how humans use it to make accurate decisions. A thorough awareness of the implications of this in the computing domain is required, and the risks and challenges this poses to data security and system integrity.

The project 'Secure environments for collaboration among ubiquitous roaming entities' (Secure) sought to explore the application of trust-based security systems for mobile and roaming computer infrastructure. The project worked on a framework for trust management. It defined a computational trust model allowing electronic entities to reason about the 'trustworthiness' of other entities for use in security-related decisions.

The model would not only enable entities to assess the potential trustworthiness of other entities. It would also balance the benefits and utility against the risks and potential costs to reach a decision on whether or not to trust a particular application or network resource.

Secure worked on a formal language for trust policies, including global and local referencing, as well as operational algorithms for distributed computation of policy trust values.

By the end of the project, Secure had defined a comprehensive methodology for the evaluation of trust-based security policies, including detailed threat analysis. What's more, it also defined separate evaluation criteria for the decision-making system as a whole and for its individual components. The whole methodology has been successfully tested on a spam filtering application.

As the domain of trust-based security reaches maturity, the ability to evaluate the effectiveness of various proposed policies becomes crucial. In this respect, Secure could prove to be a valuable tool for the whole scientific community.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5438

Finding a digital partner to trust

As computing technologies become less visible to the user, there is a greater need to regain public trust to maximise the benefits they can bring. European funding has enabled researchers to develop security mechanisms based on human notions of trust, which may prove to be part of the solution.

The vision of pervasive computing is expected to become reality when computing capabilities are woven into the fabric of everyday life until they are indistinguishable from it. It is driven, not so much by the problems of the past, but by the possibilities of the future.

In an ambient intelligence environment, real people would have a digital-self acting on their behalf. These digital entities are more likely to be artificial intelligence agents who — as in real life — will encounter other previously unknown entities while roaming from place to place.

The question raised is not really 'Who exactly does an entity represent?' but 'Can this entity be recognised as a trustworthy partner, whoever it represents?' To tackle this question, the concept of trust in computer systems has attracted the attention of researchers in the project 'Secure environments for collaboration among ubiquitous roaming entities' (Secure).

Trust is an elusive concept that defies exact definition. Moreover, like other values, trust must be gained over time. Nonetheless, they proposed that a model with explicit trust values can be developed with enough sophistication to help overcome the initial distrust and suspicion.

Building trust will require willingness to take risks in unknown situations and to allocate privileges until experience shows that it wasn't wise. Personal observations of another entity's behaviour will be essential for the subjective evaluation of its trustworthiness.

In the absence of experience, recommendations from trusted third parties may provide the opportunity to form an opinion. All the values that build trust are stored in memory. But, before interacting, digital entities are able to choose what fraction of their past to reveal, affecting the predictability of their dishonest behaviour.

This dynamic view of trust resulted in a flexible model that is able to represent trust in a way that captures human intuitions. For example, positive experiences preserve or amplify trust, while trust erodes without frequent interaction. By reflecting how trust is formed and evolves, this trust management model allows entities to reason about and make security-related decisions autonomously.

The practical experience gained through its use in file-sharing facilities can be a starting point for people to gain trust in security mechanisms. Lack of trust in security systems is clearly evident in the reluctance to accept e-commerce which is fuelled by a number of publicised attacks. The exposed weaknesses will need to be addressed before users adopt any new service.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5437

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Superconducting qubits: quantum computing gets connected

Quantum computers process complex equations to help unravel mysteries of our universe, our climate, and even genetic analysis. Understanding the relationship between quantum bits (qubit) is essential to fully exploit the awesome potential of quantum computing.

Conventional computers process information with a bit that represents a 0 or a 1. Qubits, on the other hand, have the unique ability of representing a 0, 1, or both simultaneously.

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This quirk means qubits can store and process data at the same time. Quantum computers are therefore able to solve parallel tasks using less time and memory than conventional computers.

Understanding the relationship between qubits led researchers at the EU-funded project 'Superconducting qubits: quantum computing with Josephson junctions' (SQUID) to create a detector that measures the spectroscopy and relaxation time of a flux qubit. A flux qubit is a micrometre-sized loop of superconducting metal interrupted by a number of Josephson junctions — i.e. two superconductors separated by a non-superconducting barrier.

The detection is based on a Josephson inductance of a DC-superconducting quantum interference device — a so-called DC-SQUID. The scientists obtained a relaxation time of about 80 microseconds, a superior result under the circumstances.

Normally, measuring flux qubits under these conditions would damage the underlying structure. But researchers at SQUID were able to implement a non-destructive method for the readout of a persistent current flux qubit.

The detector will enable future researchers to better understand the relation between quantum measurements and decoherence — the lifetime of a qubit.

Quantum physics applied to computing will disclose properties and possibilities never before encountered through conventional computing. The scientists at SQUID have taken us one step further.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: further research or development support;
information exchange/training; available for consultancy.
http://cordis.europa.eu/marketplace > search > offers > 5447

Breakthrough in short-haul transceiver technology

An EU-funded project is providing telecommunications (telecoms) operators with a simpler way of upgrading optical telecoms networks directly to 100 gigabit Ethernet (GbE).

Trials of the technology developed in the HECTO([1]) project have demonstrated that 100GbE networks can be deployed in a simpler capacity than before. The project was funded to the tune of EUR 2.36 million under the 'Information society technologies' thematic area of the Sixth Framework Programme (FP6).

The eight-partner project, which kicked off in 2006 and ended in 2010, aimed to develop photonic components, particularly transmitters and receivers for high-performance, high-speed and cost-efficient communication systems.

Coordinated by the Finnish telecoms provider Nokia Siemens Networks, HECTO brought together experts from academic institutions, research institutes and small and medium-sized enterprises in Denmark, Germany, Greece, Finland and Sweden. Nokia Siemens Networks used its extensive experience in the project's high-transmission trials, systems evaluation lab experiments and field trials. It also served as the interface between the project and telecoms standardisation organisations.

The consortium's main work centred on developing packaged transmitters and receivers for optical systems based on 100GbE signals, determining specifications for all interfaces of the photonic components, and identifying application areas for the components and their impact on the specifications. The HECTO partners also carried out tests on the packaged transmitters and receivers in laboratory system test-beds.

HECTO successfully developed a method that cuts the number of transceivers (the components that send and receive pulses of information carrying light) for 100GbE network links of less than 40 kilometres. Thanks to the new HECTO technology, telecoms operators will be able to provide short-haul 100GbE using only one single wavelength transceiver rather than using four at four separate wavelengths, which is the current procedure.

'100GbE is the next big step in the networking world, bringing the additional capacity that will be needed for new bandwidth-hungry applications and the widespread adoption of smart devices,' said Rainer H Derksen from Nokia Siemens Networks. 'The HECTO approach is ideal for short-haul transmissions because it does not require the complex transceivers needed for longer distance network links.

'100GbE is the next big step in the networking world, bringing the additional capacity that will be needed for new bandwidth-hungry applications and the widespread adoption of smart devices'.

'At the same time, it meets the increased capacity demands in the metro and access portions of the network. This landmark project fits well with our vision of using innovation to help operators upgrade to 100GbE without major network investments.'

The consortium members now have plans to exploit the project's results through their SME members.

Other HECTO project partners include the Swedish groups Royal Institute of Technology (KTH), Acreo AB and Syntune AB, the Germany-based Fraunhofer Heinrich Hertz Institute, Fraunhofer Institute Applied Solid State Physics, and u2t photonics AG, as well as DTU Fotonik of Denmark, and the University of the Peloponnese in Greece.

(1) 'High-speed electro-optical components for integrated transmitter and receiver in optical communications.'

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 16273

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Addressing internet expansion

The growth of the internet is putting a strain on its underlying architecture. However, one EU-funded project has studied new ways of helping ensure that the Internet can continue to expand and deliver increasingly complex services well into the future.

The researchers' aim was a simple one — help test technology that will support the continued expansion of the internet for years to come. With funding worth EUR 18 million, researchers built and tested a network joining 35 partners in 14 countries.

Whenever a website is set up, it is assigned a number. Until recently, the internet has used a system of four sets of numbers which constitute a website or service's 'home'. For example, the number 66.249.65.140 corresponds to the 'web bot' of the popular Google search engine. This address system is called IPv4.

With living areas in cyberspace becoming increasingly scarce, the addition of two more number sets will make continued expansion easier. This new system is called IPv6. Neither system should be confused with the uniform resource locator (URL) of a website, which is often used in place of the address.

The main aims of the 'Large-scale international IPv6 testbed' (6NET) project were to gain experience in rolling out a new IPv6 network and migrating from the existing IPv4 system. The project also used its infrastructure to extensively test an array of new services and applications made possible by IPv6. This latter function was especially important, since IPv6 makes a range of new products and services that are not possible within the IPv4 framework.

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The wider results of the 6NET project have been turned into a number of so-called 'cookbooks' for network administrators, IT managers, network researchers and those interested in deploying IPv6. Volumes on general reference and specific deployment scenarios (such as site transition, multicast, mobility, or routing) are available.

Early in the project, support for multicasting using IPv6 was recognised as highly important, since many applications use multicast technology. Making a generic, simple and scalable mechanism which could provide globally unique multicast addresses for user groups within specified time periods was required, as existent mechanisms were not globally reliable. At the same time, a complete taxonomy of the IPv6 multicast addresses allocation problem was developed.

By developing a complementary allocation mechanism for collision avoidance, further research in the areas of bandwidth preservation, multicast security and broadcast efficiency are now possible.

Funded under the FP5 programme IST
(User-friendly information society).
Collaboration sought: further research or development support.
http://cordis.europa.eu/marketplace > search > offers > 5448

Seeing is understanding — using artificial intelligence to analyse multimedia content

The media produce a glut of material daily. Refining that ore into the gold of useful information requires new approaches. European researchers have now made automated multimedia analysis much smarter.

Picture a few seconds of coverage from a sporting event, say the Wimbledon finals. Your television might show a snippet of action plus the players' names, scores, and other text scrolling across the screen, while the audio feed might feature expert commentary.

Multiply that multimedia feed by every sporting event being broadcast anywhere in the world. Then toss in all the other activities covered by the media — news, politics, pop culture, not to mention YouTube and other social media. And finally, imagine trying to make sense of this torrent of information so that it can be categorised, labelled, indexed, searched and retrieved as needed.

That's the challenge that the EU-funded research project 'Bootstrapping ontology evolution with multimedia information extraction' (Boemie) accepted in 2006. They've now shown that by using state-of-the-art artificial intelligence (AI) techniques to build and then refine highly structured knowledge bases, they can automatically or semi-automatically identify, analyse and index almost any multimedia content.

Boemie's smart toolkit has significant commercial and research potential in any kind of multimedia annotation and retrieval. 'Without semantic indexing, it's very difficult to retrieve multimedia content,' says George Paliouras, Boemie's technical manager. '[The project] offers a new approach to do this at a large scale and with high precision.'

It's impossible to pick oneself up by one's own bootstraps, but Boemie manages a close approximation.

Of necessity, Boemie needs to start with some knowledge of the domain it will be analysing. That basic knowledge comes from domain experts who are prompted by the 'Boemie semantic manager' to define and relate key concepts using natural language. For example, the concept 'tennis match' might be defined as a type of sporting event, and the concept 'Wimbledon finals' might be defined as an example of a tennis match.

Boemie automatically organises this information into an ontology — a formal way of representing concepts and the relationships between them within a chosen domain. Many AI applications use ontologies to represent knowledge about specific areas in a systematic and useful way.

When Boemie starts to analyse a multimedia feed, it uses newly developed video, image, audio and text analysis tools to extract as much information as it can. From the Wimbledon coverage, for example, it might note that there are two players interacting across a net on a playing surface of a particular size. This might allow it to categorise what it is 'viewing' as a tennis match. From the audio track or on-screen text, it might tentatively connect the players with their names.

As the 'Boemie ontology evolution toolkit' tries to place the information it extracts into the existing ontology, it's likely to discover that it needs new concepts. For example, it might notice that the commentator repeatedly uses the word 'championship' or the phrase 'Grand Slam'. The system automatically proposes these new concepts for the ontology, which can be accepted, rejected or modified by the domain expert.

Much like a human researcher, Boemie searches the web for needed information. For example, it might access Wikipedia or other sources to define a Grand Slam event, find out where Wimbledon is located in order to place it on a map, or find biographies of the contestants.

The key bootstrapping cycle is managed by the 'Boemie bootstrapping controller'. After enriching the knowledge base, the system then re-analyses the same footage, guided by the newly enriched ontology. This lets the system extract even more information and propose still more refinements to the knowledge base.

'This cycle of improvement of our domain knowledge and then going back with that improved knowledge to extract even more knowledge can happen several times,' says Mr Paliouras. 'This is the novel aspect of Boemie.'

The Boemie package also includes a semantic browser that allows non-expert users to search for the multimedia information they need using the concepts and relationships Boemie has built up.

The Boemie researchers decided to test the system in the area of sports, where they knew they could find plenty of multimedia content and would not need to involve specialists to help build the knowledge base.

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They found that the combination of Boemie's content analysis tools, the natural language interface and flexible ontology building tool, and their novel bootstrapping approach allowed them to extract information from multimedia sports coverage much more efficiently and accurately than existing automated systems.

Mr Paliouras points out that Boemie is not limited to sports. The toolkit can speed and improve the analysis, categorisation, indexing and retrieval of almost any kind of multimedia content. 'Boemie can add value to any form of multimedia analysis, and make the work of a domain expert easier and more manageable,' he says.

Project coordinator Constantine Spyropoulos notes that a variety of potential customers are interested in implementing parts of the Boemie toolkit. The International Association of Athletics Federations wants to boost its content retrieval capabilities using Boemie. Advertisers are interested in how Boemie can help them reach particular audiences and monitor the exposure of their products. Politicians are intrigued by Boemie's ability to filter a torrent of information to determine what people are saying about a particular issue, and news organisations are exploring how the system can help them.

'The methodology we've developed is universal,' says Mr Spyropoulos. 'It can apply to any area, any domain.'

The Boemie 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=91283

Broadway produces: broadband access in busy hotspots

European researchers have produced a chip amplifier that provides high-speed wireless broadband connectivity in densely populated areas and WiFi hotspots without sacrificing user connectivity.

The project 'The way to broadband access at 60GHz' (Broadway) aimed to bridge the broadband connectivity gap between the 5GHz and 59-65GHz scale. The partners used a dual frequency hybrid system employing chip amplifiers to speed up connection speeds.

Known as monolithic microwave integrated circuits (MMICs), these chip amplifiers can operate at frequencies of between 300MHz and 300GHz. MMICs are easier to use than traditional integrated circuits because cascading them does not then require an external matching network.

Previously, this technology was the preserve of space and military technology due to high costs and complexity. However, recent advances have led to wider applications in devices where small size does matter, such as in mobile phones.

One major outcome of the Broadway project, funded by the EU's Sixth Framework Programme (FP6) for research, has been the design of advanced MMICs for boosting system performance. Prototypes of the various advanced MMIC blocks have also been developed, including single and two-stage amplifiers, branch-line mixers, as

➔

well as local oscillator (LO) buffer amplifiers. The project also created a number of test structures for process and design analysis.

In addition, Broadway released a package of 60GHz custom-designed chips. The overall cost of the unit has to be kept as low as possible. Achieving this, especially considering that the unit operates at 60GHz, was an enormous challenge.

In an attempt to reduce the cost and to use the in-house 'pick and place' machine, the project pursued a completely novel approach. All the radio frequency (RF) components were located on one side of the unit and all direct current (DC) components on the other. This reduces the RF leakage to the DC components to a minimum and also streamlines the assembly of the units.

Broadway's innovations have paved the way for the 'internet anywhere, anytime paradigm' which mobile Europeans can increasingly take for granted.

Funded under the FP5 programme IST (User-friendly information society).
Collaboration sought: information exchange/training.
http://cordis.europa.eu/marketplace > search > offers > 5439

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Software for seabed toxic waste

Toxic waste dumped at sea poses a hazard to both marine ecosystems and the human population. European researchers developed innovative solutions to overcome the technological and scientific challenges faced when investigating toxic waste sites in the seabed.

Effective management of toxic waste buried in the seafloor demands that it be properly mapped and the potential environmental impact correctly assessed. A lack of reliable information can result in serious consequences for marine life and human activities, such as fishing.

Conventional methods have proved ineffective at determining the location and size of dumped containers buried under sediment. The use of new techniques can enable both known and suspected dumpsites to be effectively investigated in a cost-effective way.

The European project 'Seafloor imaging and toxicity: assessment of risks caused by buried waste' (SITAR) developed 3D acoustic imaging methods for examining the contents of toxic dumpsites, including small containers deposited within the seabed. The consortium produced and tested geographical information system (GIS) and software tools for handling environmental, biotoxicological and geographic field data. The information is displayed according to the user's specifications and measurements can be compared according to time and space.

Instrumentation developed by the SITAR consortium was first tested under carefully controlled conditions at a known toxic waste site in the Baltic Sea. The system was evaluated and verified by end-users who were able to study the distribution of containers around a dumpsite.

Information provided by the equipment produced by the SITAR project will help decision-makers to manage seabed dumping sites effectively. Improved management of sites will enable Europe's marine environment and human population to be better protected from toxic waste.

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Funded under the FP5 programme EESD (Energy, environmental and sustainable development).
Collaboration sought: further research or development support; joint venture agreement; manufacturing agreement; information exchange/training; private-public partnership; available for consultancy.
http://cordis.europa.eu/marketplace > search > offers > 5434

Fab new laser nano-fabrication technology

Laser interference lithography can produce very high-resolution nano-scale surface patterns at low cost, and now European researchers have made important breakthroughs in the area.

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Two important breakthroughs by European researchers have brought an emerging nano-scale fabrication technology out of the lab and into the real world. The technique promises lower cost production of nano-devices at higher resolutions.

It will mean better and cheaper production methods for such things as self-cleaning materials, nano-sensors and gratings, nano-filters for clean air and water and special anti-reflection surfaces for solar technology.

Interference lithography is a surface patterning technique that has generated enormous interest in labs across the world. But the Delila([1]) project took it out of the lab and proved the technique could work on a commercial scale, all the while achieving world-class breakthroughs. The technology will be helping to create the next wave of nanotechnology in two to three years.

Laser interference lithography creates surface patterns by splitting a coherent beam of light, say a laser beam, and then recombining the light very precisely, so that the split beams cross and create patterns of interference. Added together, these patterns produce a surface pattern on material, which can then be processed in the normal manner.

Interference lithography is attractive because it allows the fast generation of dense features over a wide area without loss of focus. It is also costs less to build these production lines because they do not require complex optical technology or photomasks.

The savings are very significant. Where typical fabrication systems cost in the millions of euros, systems based on Delila's breakthroughs would cost just in the hundreds of thousands.

'It is known that nanotechnology will play a dominant role in this century in almost all the scientific and industrial areas for development of new materials, devices and systems,' points out Zuobin Wang, coordinator of the Delila project and a senior research fellow at the University of Cardiff's Manufacturing Engineering Centre (MEC). 'However, the key problem remains the lack of low cost and volume manufacturing technologies and systems.'

'We focused on the development of a new production technology for fabricating 2D and 3D nano-structures and devices, laser interference lithography. In particular, Delila will enable low-cost and large-volume production of nano-surface structures and patterns.'

In addition to being cheaper, Delila's method can print 2D and 3D nano-structures. It makes it perfect for nano-photonic and nano-electronic devices and micro and nano-fluidic devices.

Nano-fluidics is a field of nanotechnology that looks at the behaviour of fluids at extremely small dimensions — acting in a manner that can be manipulated predictably. It has many applications in manufacturing where fluids are involved, such as testing tiny samples of a drug, for example. The field is still in its infancy but already it is having an enormous impact. Delila will give it a new tool.

The team attacked the problem on a broad front, looking at everything from the technological potential of multiple beam interference to user needs. The main focus of the work, however, was in building a viable production prototype.

Here the problem was integrating the various elements within the system and then perfecting each element. A key breakthrough occurred with the tuning part of the work, manipulating light to create the interference in the patterns and at the scales required.

Delila showed for the first time feature sizes of ~30nm for direct writing and ~5nm for modification of nano-structures. These are state-of-the-art results for the technology.

Direct writing is where laser beam interference etches patterns directly onto a die, without using a photomask. It is much cheaper than standard processes for achieving the required features. The 30nm result refers to the systems capacity to create precise feature sizes in the desired pattern.

The structure modification result, however, is in many ways more interesting. This is the smallest possible structure that the system can achieve right now. It is currently not sufficiently precise for commercial application, but the fact that Delila was able to achieve any modification at this scale indicates that it will be possible to achieve the required precision for commercial purposes. This will be the next research goal.

The team had a busy schedule during the project. In addition to producing the breakthrough results, the team submitted five patent applications and more than 20 technical publications, many more than were expected.

Aspects of their work have direct market relevance now, with commercial products based on Delila's results slated to start fabricating real devices in the next two to three years.

Perhaps even more exciting, however, is the prospect of much greater advances in the technology in the near future.

Delila achieved structures of just 5nm using the technology. Although this result is also not yet commercially ready, Wang believes the team can achieve commercial 5nm direct writing with laser interference lithography in the next five years.

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

(1) 'Development of lithography technology for nanoscale structuring of materials using laser beam interference.'

Promoted through the ICT Results service.
http://cordis.europa.eu/ictresults/index.cfm?section=news&tpl=article&id=91271

Mimicking the body's natural processes

An EU-funded research team at Norway's University of Bergen is using nanotechnology to find a way of mimicking the body's natural processes, including inducing cells to create new blood vessels for biomedically-engineered tissues.

The University of Bergen is involved in several major EU-funded projects, such as 'Construction kit for tailor-made vascularised bone implants' (Vascubone), which has 15 partners and EUR 12 million of research funding under the Cooperation programme of the Seventh Framework Programme (FP7). The project's remit is to improve the formation of blood vessels during the regeneration of new bone tissue.

Biomedical and nanotechnology researchers around the world are working hard to induce cells to create new tissues. But all tissues need a blood supply and that is what the University of Bergen research team is focusing on.

The team is looking at how to nanotechnology can mimic the natural processes of the body. To do so, they are investigating how cells interact with each other and with synthetic biomaterials, and what the process of regeneration involves. The aim is to understand and then copy the cells' natural mechanisms for the regeneration and engineering of new tissues.

'An ideal implant,' explained research team head Professor James Lorens from the University of Bergen, 'should mimic the body's natural tissues and send proliferation and differentiation signals to the cells. The nanoscale topology is vital for controlling how this occurs.

'A primary challenge with any tissue formation, however, is securing the blood supply to the new tissue. In other words, making sure that blood vessels are formed within the tissue.'

Professor Lorens' team is working on the blood supply aspect of tissue engineering and has already succeeded in placing three blood vessel components (epithelial and smooth muscle cells as well as matrix proteins) into an implant where cells are connected to new tissue. The experiment was successful in both Petri dishes and small implants in animals.

'We have demonstrated vessel formation in synthetic implants in our lab animals,' said Professor Lorens. 'In the next phase, we'll examine more specific tissue types such as bone tissue, for example.'

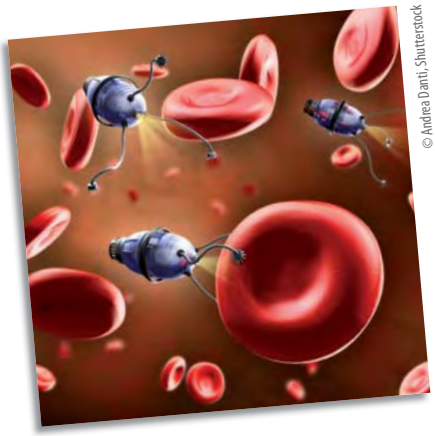
The team is also looking at ways of using nanotechnology for direct cell communication. To determine how nano-structured surfaces affect blood vessel formation, the researchers placed cells on a nano-structured biomaterial, the surface of which had been treated with certain molecules that send specific signals to cells.

'We need a better understanding of how cells perceive nanofabricated surfaces and how this affects communication between cells,' said Professor Lorens. 'By reproducing the signals that cells encounter from their immediate surroundings inside the body's various tissues, we can control how the cells proliferate and differentiate.'

Part of the research group's work is to establish how these processes work in cancerous tissues. Professor Lorens commented, 'With tissue engineering we can reproduce a tumour in order to study how it interacts with blood vessels. If we succeed in cutting the blood supply to the tumour, it will starve and die. Tumour tissue engineering can also help us to understand how cancer cells spread via blood circulation.'

The University of Bergen team is also involved in an EU collaboration to find new medications that can block the blood supply to cancerous tissues, in effect starving the cancer by depriving it of blood.

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 15873



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Estonians put Roboswarm technology to the test

Invent Baltics, an Estonian R&D consultancy group, has successfully tested the swarm coordination technology demonstrator that was designed and developed by a European-funded project.

The project, 'Knowledge environment for interacting robot swarms' (Roboswarm), received almost EUR 1.7 million under the 'Information society technologies' thematic area of the Sixth Framework Programme (FP6).

Launched in 2006 and finalised in 2009, Roboswarm targeted the development of a technology for self-configurable, inexpensive and robust robot swarms that people could use in various applications on a daily basis including, among others, cleaning, patrolling and escorting. A robot swarm is similar to a colony of ants: with a higher collective intelligence, the swarm may be used to accomplish tasks that lie beyond the capabilities of a single robot.

Bringing together nine research and industry partners from seven countries, Roboswarm fulfilled its goal of developing a demonstrator that is composed of 10 to 15 devices and that allows a swarm of simple robots to perform a number of cleaning tasks.

The project partners used fixed radio frequency identification (RFID) tags to help the swarms with positioning and navigation. The tags are used by the robots for coordination and task sharing, and are marked with various surfaces and objects.

Thanks to the Roboswarm technology, simple robots will be able to communicate extensively so as to split individual tasks in order to heighten the functionality of the swarm (i.e. scalability), to learn from the experience of individual swarm members through the local or international knowledge base (i.e. self-learning), and to operate with as few sensing capabilities as possible (i.e. cost efficiency).

Experts say there is a growing interest in the multi-robot system (MRS) where several robots interact to achieve common goals; the potential to perform coordinated tasks compared to a single robot system effectively save time, money and effort.

Microsoft Research in the US has already expressed an interest in the Roboswarm technology.

Roboswarm is coordinated by the Department of Computer Science at Tallinn University of Technology in Estonia, and brings together teams from Spain, Estonia, France, Italy, Portugal, Finland and Sweden.

Promoted through the Research Information Centre.
http://ec.europa.eu/research/infocentre > search > 14693

Ultrasound cleaning improves membrane efficiency

The use of ultrasound (US) for cleaning bio-membrane filters contaminated with organic material was investigated by EU-funded researchers who combined membrane technology with activated sludge treatment to remove organic matter from wastewater.

Agricultural industries such as brewing and food processing require enormous amounts of water which become contaminated with organic matter. This material is contained in wastewater, requiring biological treatment at a water treatment plant before being discharged into large settlement tanks. By replacing the use of tanks with a membrane biological reactor (MBR) system, the concentration of dry material can be increased. The material can then be reused in the form of fertiliser and soil conditioner.

The use of membrane technology also increases the concentration of beneficial micro-organisms which help boost the cleaning ability of the system. The drawback to MBR is that its effectiveness is reduced through scaling and the build-up of unwanted matter. The result is that large quantities of chemicals and considerable time and effort are required to clean and maintain these membranes.

The Agroiwatech([1]) project investigated the use of US for cleaning membranes while still in the system to improve their efficiency. This technology has a lower environmental impact than conventional techniques because it uses fewer chemicals and less energy. The consortium studied different membranes with test substances at different US frequencies to determine the flux rate compared to pressure.

Researchers selected one membrane in particular for further study, subjecting it to US at a frequency of 15.5KHz. Results showed that US did not damage the membrane and improved the flux rate. However, after nine hours the membrane surface required cleaning in the conventional way. Following these initial tests researchers built small modules and an MBR system for further study.

Wastewater was treated with activated sludge and filtered using the membrane module. Activated sludge is wastewater containing air and micro-organisms causing the aggregation of organic matter. Following this dual treatment both the organic and ammonia content were significantly reduced, giving a much more efficient result than using the membrane alone.

Cost-effective recovery of potentially useful resources from wastewater constitutes an extra bonus in the bid to clean up Europe's heavily polluted waterways. Fertiliser and biogas fuel produced with a low energy bill will almost certainly prove to be very attractive possibilities for the direction of agro-industry.

(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.
http://cordis.europa.eu/marketplace > search > offers > 5412

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

Home, migration and the city: new narratives, new methodologies

A five-day conference that re-examines migration and its shifting influence on identity, in both social and political contexts, will be held in Linköping, Sweden from 6 to 10 August, 2010.

A borderless Europe increases the fluidity of movement of both goods and people. In a sense, it is redefining identities that are no longer bound to a specific geography. This conference, organised by the European Science Foundation, and chaired by the London School of Economics, will explore migration's role in the fundamental transformation of spaces and places that are linked to the social and cultural meanings of home and belonging. The concept of home, according to researchers, can also be described as translocal, transnational and diasporic — shaped by consumption, remittances and social networks.

For further information, please visit:
http://www.esf.org/index.php?id=6500

International sports sciences and sports medicine

Europe's premier sports sciences and sports medicine conference will be held in Newcastle Upon Tyne, England from 19 to 21 August, 2010.

The three-day programme brings together leading experts in both sports science and sports medicine in the build up to the 2012 Olympics and Paralympic Games. The first two days of the conference will run parallel sessions on sports science and sports medicine. Each day will feature one plenary session open to all conference delegates. The final day will host a series of presentations and discussions with an aim to expedite practical information for coaches, team doctors, and sports science support staff. The principal organiser of the event is Northumbria University, UK.

For further information, please visit:
http://www.isssmc.com

Epigenetics and stem cells conference

The University of Copenhagen in Denmark will host this conference from 25 to 27 August, 2010.

The conference aims to provide a forum for discussing the connections between epigenetic regulation of transcription, stem cell proliferation and the development of cancer. Diseases, like cancer, are linked to stem cells through development and differentiation. Epigenetic regulation of transcription is believed to provide a memory system that regulates differentiation of stem cells and therefore cell fate decisions.

For further information, please visit:
http://tiny.cc/r7jo1

European Society of Cardiology congress 2010

This congress, organised by the European Society of Cardiology, will be held in Stockholm, Sweden from 28 August to 1 September, 2010.

With over 30 lecture halls, and delegates and experts from more than 150 countries, the congress on cardiology will present over 4 000 abstracts. The aim is to help reduce the burden of cardiovascular disease in Europe. A separate exhibition hall will host 200 organisations. These organisations will display the latest in cardiovascular technology and products.

For further information, please visit:
http://www.escardio.org/congresses/esc-2010/Pages/welcome.aspx

The 23rd congress of the European College of Neuropsychopharmacology

Amsterdam, the Netherlands, will be hosting this long-standing conference from 28 August to 1 September, 2010.

The European College of Neuropsychopharmacology (ECNP) is set to attract more than 150 speakers from 20 countries to a congress where an estimated 7 000 people will attend. A broad range of topics on neuropsychopharmacology and mental disorders in Europe will be discussed. Thirty-five session experts will present their latest achievements in brain research and neuropsychopharmacology in both preclinical and clinical settings, and discuss the various aspects of pharmacotherapy for patients with mental disorders and their impact on quality of life.

For further information, please visit:
http://www.ecnp.eu/emc.asp

ESA international summer school on GNSS

The European Space Agency's (ESA) international summer school on global navigation satellite systems (GNSS) will be held in Slettestran, Denmark from 1 to 11 September 2010.

The summer school, partly organised by ESA, is open to graduate students, PhD candidates, early-stage researchers and young professionals. The objective is to provide attendees with a comprehensive overview on the design and development of satellite navigation systems as well their applications.

Aside from the lectures on fundamentals, topics will address equivalent global and regional navigation systems such as the US Global Positioning System, the European Galileo system, the Japanese Quasi-Zenith Satellite System and the Indian Regional Navigation Satellite System.

For further information, please visit:
http://munich-satellite-navigation-summerschool.org/

Linz-congress: alternatives to animal testing

The Linz-congress will be held in Linz, Austria from 2 to 4 September, 2010.

The Linz-congress, organised by the European Society for Alternatives to Animal Testing, combines two separate conferences into one. Along with the conference on alternatives to animal testing, the congress will also host the 16th International Congress on In Vitro Toxicology.

Linz-congress will therefore present participants with the latest developments and research methodologies in the fields. Discussions will centre around the correlation between *in vitro* data and human data. The forum will also discuss the latest developments in European chemicals and cosmetics policy in context with the use of alternatives methods. The congress is placing emphasis on poster sessions.

For further information, please visit:
http://www.eusaat.org/index.php/2010

Bacterial networks 2010

This European Science Foundation research event will take place in Sant Feliu de Guixols, Spain from 4 to 9 September, 2010.

World-leading scientists from different areas of molecular microbiology, computational modelling, and systems biology, will meet to discuss the mechanisms and principles of information collection, integration and implementation for bacteria. There will also be a series of sessions on global regulation, networks and switches, network modelling and engineering, microbial cell biology, microbial development, stress response, and cell-to-cell communication.

The aim is to bring together related but often non-intersecting fields in the hope of generating new ideas and concepts for modern-day microbiology.

For further information, please visit:
http://www.esf.org/index.php?id=6455

Conference on cellular host-pathogen interactions

This cell biology conference will be held in Amsterdam, the Netherlands, from 5 to 7 September, 2010.

The three-day conference, sponsored by the Current Opinion journals, aims to provide new direct links between world-leading scientists and attending delegates. The conference will cover all areas of molecular and clinical research within this topic, including pathogen invasion, adaptation, host defence, pathogen life cycle and immune system response. The conference emphasises the latest unpublished results, discussions, and contact between experts. Sessions are designed to facilitate networking.

For further information, please visit:
http://conferences.current-opinion.com

From varying couplings to fundamental physics

This symposium is part of the Joint European and National Astronomy Meeting (JENAM) and will be held in Portugal, Lisbon on 6 and 7 September, 2010.

Understanding the building blocks of the Universe requires a thorough examination of the properties of physical laws and fundamental dimensionless couplings. Currently, no 'theory of constants' exists describing the role of couplings in the underlying theories and how they relate to one another or how many of them are truly fundamental.

JENAM aims to bring together the most active researchers in the field to discuss the latest developments and explore ways on how to best create synergies among European research facilities.

For further information, please visit:
http://www.astro.up.pt/investigacao/conferencias/vfc2010

Submarine paleoseismology: the offshore search of large holocene earthquakes

This unique conference will be held in Obergurgl, Austria from 11 to 16 September, 2010.

Submarine paleoseismology is a new field of research that merges and integrates paleoseismology and marine geology. The six-day conference will aim to establish synergies between researchers already established in the field and those who are interested in pursuing submarine paleoseismology.

According to conference organisers — the European Science Foundation and Leopold Franzens University Innsbruck — submarine paleoseismology has several unique advantages that will add to the current knowledge on holocene faulting and paleoseismicity traditionally obtained from research on land.

For further information, please visit:
http://www.esf.org/index.php?id=6484

ICT2010

A leading European conference, expo and networking event, bringing together experts and stakeholders in the field of information and communications technology (ICT), will be held from 27 to 29 September in Brussels, Belgium.

ICT2010 has been described as 'Europe's most visible forum for ICT research and innovation'. This biennial event is a unique gathering point for researchers, business people, investors, and high-level policy-makers in the field of digital innovation. Under the banner 'Digitally driven', this year's edition will take place in Brussels Expo and is being organised by the European Commission in cooperation with the Belgian Presidency of the Council of the European Union. The two main themes for ICT2010 are 'ICT for sustainable growth in a low-carbon economy' and 'ICT for and by the citizen'. More than 4 000 participants are expected to attend the event and the results of over 100 cutting-edge ICT research projects will feature in the exhibition.

For further information, please visit:
http://ec.europa.eu/information_society/events/ict/2010

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