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RTD Results Supplement

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Technology Opportunities
Recent highlights from the CORDIS Technology Marketplace

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EDITORIAL

The long road to instant rapport

There was a time when working a computer involved learning a whole new language, composed of arcane commands and stringent syntax. Then came the graphical user interface, and with it the ongoing quest for increased user-friendliness. And the computers of the future will not only speak our language, but will also be able to interpret our moods, anticipate our needs, and deliver the assistance we require with a minimum of fuss.

The quality of human-computer interaction is key to the usability of information technology. This interaction has many facets, several of which relate to content. Making sense of content and providing quality content accessible to all require a detailed analysis of the contents flowing back and forth between user and machine, and the way they are presented at the user interface. Much depends on the purpose the machine serves and how it interacts with users: whether what needs to be represented is simply text or rather speech, or perhaps the imprint of touch while handling digital objects in a virtual or augmented reality scenario.

Another major challenge lies in enabling machines and other artificial systems to understand content in all its forms, and in Europe's many languages. This includes raw content as we see and hear it, as well as the analysis of multimedia and multimodal content. Of course we do not want systems to understand for the sake of understanding, but for the sake of acting purposefully, of making good decisions and of communicating with us in the real world.

This has wide implications in many areas; notably for the construction of machines that can carry out services which require physical action. The basic technologies are there and we can now move on to integrating them in complete systems which are more robust and more flexible in their response to what is going on in their working environment.

One of the biggest challenges, however, is to make machines truly understand their users: not only what they say or write but also their intentions and, perhaps, frustrations. This requires capabilities that we would describe in human terms as 'cognitive'. Endowing machines with such capabilities is an ambitious research goal. It is also one of the areas where our multidisciplinary research teams truly come into their own, drawing on technological vision and groundbreaking insights into the biological world to bridge the gap between carbon and silicon while advancing our understanding of what makes us human.

This issue of the CORDIS focus RTD Results Supplement features a range of trailblazing technologies that explore our interaction with machines. From artificial intelligence to neuroinformatics, from robotics to complex systems, European research is rising to formidable engineering challenges in designing efficient, user-friendly applications and services which will improve our quality of life, help us to build a more inclusive society, and boost the competitiveness of our businesses.

Many of the articles featured here were supplied by the IST Results service (http://istresults.cordis.europa.eu), which provides news and articles on the latest innovations from the information society technologies (IST) research initiative. IST Results will contribute further material to future issues of the Supplement, complementing the regular overview of recent technology offers published on the CORDIS Technology Marketplace: http://cordis.europa.eu/marketplace

The biology and medicine section leads with the description of a molecular switch which will permit a closer integration of natural and artificial constructs. The IT and telecommunications section presents smart homes, where the controls for most appliances are interconnected and voice-activated. Demonstrating that plants might also benefit from dialogue with machines, the environment section describes a system enabling them to control their growing conditions. Follow the circuit logo for more technologies helping to build our interactive future.

The CORDIS focus team hopes you will enjoy this edition and looks forward to your feedback.

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Frequent acronyms

CORDIS	Community Research and Development Information Service	ICT	information and communication technologies
		IP	integrated project
ERA	European research area	IRC	innovation relay centre
FET	future and emerging technologies	IST	information society technologies
FP5	Fifth Framework Programme of the European Community for research, technological development and demonstration activities	R & D	research and development
		RTD	research and technological development
		SME	small and medium-sized enterprise
FP6	Sixth Framework Programme of the European Community for research, technological development and demonstration activities		

Nanomachine switches between biological and silicon worlds

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Scientists have created a molecular switch that could play a key role in thousands of nanotech applications. The Mol-Switch project successfully developed a demonstrator to prove the principle, despite deep scepticism from specialist colleagues in biotechnology and biophysics.

'Frankly, some researchers didn't think what we were attempting was possible because standard descriptions in physics, for example the Stokes equation for viscosity, indicated that the system might not work. But viscous forces do not apply at the nanoscale', says Dr Keith Firman, reader in molecular biotechnology at Portsmouth University and coordinator of the Mol-Switch project funded under the 'Future and emerging technologies' (FET) initiative of the European Commission's IST programme. 'However, we got our molecular switch to work.'

The upshot is that the Mol-Switch project was far more successful than expected. The team's switch works with a number of DNA-based motors and can achieve incredible performance.

Specific sensors, which emit electrons, can tell if the biological motor is working, so the switch links the biological world with the silicon world of electronic signals.

Here's how it works. The team uses a microfluidics chip that includes a number of channels measured in nanometres. The novelty of microfluidics is that it can channel liquids in laminar, or predictable, flow.

The floor of this channel is peppered with Hall effect sensors. The Hall effect describes how a magnetic field influences an electric current. That influence can be measured to a high degree of accuracy. These measurements link the biological motor with the electronic signals of the silicon world.

The biological element of the device starts with a DNA molecule that is fixed to the floor of the microfluidic channel. This strand is held upright, like a string held up by a weather balloon, by anchoring the floating end of the DNA strand to a magnetic bead, itself held up under the influence of magnetism.

A specific type of protein, called a restriction-modification enzyme, provides one of the DNA motors. The novelty of this type of DNA motor is that it will only bind to a specific sequence of the DNA bases A, C, G and T. 'This binding is very specific, a motor will bind only with its corresponding bases, so you can control exactly where the motor is placed on the vertical DNA strand', says Firman.

The motor is attached to the strand at the specific sequence of bases. Then the team introduces ATP, the phosphate molecule that provides energy within living cells, into the microfluidics channel. This is the fuel for the motor. The motor then pulls the upright DNA strand through it until it reaches the magnetic bead, like a winch lowering a weather balloon.

A Hall effect sensor can measure the vertical movement of the magnetic bead which indicates whether the switch is on or off. That, in an over-simplified nutshell, is the essence of the molecular switch, an actuator for the nano-scale world.

This is particularly important because a nano-scale actuator will be immensely useful. An actuator is a mechanism that supplies and transmits a measured amount of energy for the operation of another mechanism or system. It can be a simple mechanical device, converting various forms of energy to rotating or linear mechanical energy. Or it can convert mechanical action into an electrical signal. It works both ways.

'The light switch, the button that makes a retractable pen, all these are actuators, and by developing a molecular switch we've created a tiny actuator that could be used in an equally vast number of applications', says Firman.

The number of potential applications is staggering. They can be used for flow-control valves, pumps, positioning drives, motors, switches, relays and biosensors.

The system could be used to develop molecular circuits, or even molecular scale mechanical devices. The potential applications are difficult to predict, but are only limited by the imagination of researchers, such is the versatility of an actuator on this scale.

'It could be used as a communicator between the biological and silicon worlds. I could see it providing an interface between muscle and external devices, through its use of ATP, in human implants. Such an application is still 20 or 30 years away', says Firman. 'It's very exciting and right now we're applying for a patent for the basic concepts.'

One hugely important application is DNA sequencing, discovering the order of the four DNA bases, the absolutely fundamental step for genetic research. This is almost a 'bonus' application, a happy side effect of the actuator's operation.

The team used the Mol-Switch with time-resolved fluorescence for DNA sequencing. The team used fluorescence resonance energy transfer (FRET) between a fluorescent molecule on the motor and a fluorescent molecule in the DNA sample to be sequenced.

'Knowing the speed of the motor, which is quite reliable and steady at any specific temperature, we could locate the position of the DNA-based fluor [molecule] relative to the binding site of the motor', says Firman. 'More work needs to be done. However, the concept is sound and we now have enough evidence to indicate that this could be used to sequence single-nucleotide polymorphisms that cause genetic disorders.'

The team investigated a number of DNA motors for the project, notably EcoR124I and FtsK. Both worked and both offered specific advantages, with the EcoR124I providing greater flexibility and the FtsK providing greater speed.

'We're applying for a new project under the [EU's] "New and emerging science and technology" (NEST) scheme and, if that's successful, we will be able to develop a commercial product for biosensing', concludes Firman.
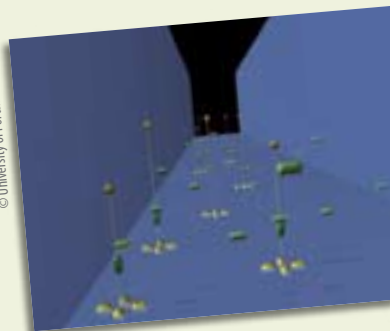
Furthering osteoarthritis research

Osteoarthritis can be a debilitating condition affecting joints throughout the body. A number of aspects behind the manifested pathology are still unclear; thus, research for effective pharmaceutical remedies is ongoing.

The EU-funded project 'Cytokines destr OA' concentrated on the role of cytokines in osteoarthritis (OA). OA is an autoimmune disease, which essentially means that the body's own immune system turns on particular components of the human body, failing to recognise them as 'self'.

Cytokines are proteins involved in a number of immune functions, including inflammation. Project partner University Medical Centre Nijmegen set out to investigate their role in OA pathology. One of the first stages

of that process is to develop the necessary tools based on which research can be carried out.

Researchers developed an osteoarthritis murine model with the intention of using it for drug screenings. In other words, such models can be used to test the efficacy of potentially useful compounds in animal tests. The specific OA model is being optimised and efforts are focused in reducing the variability associated with OA pathology induction.

The University Medical Centre Nijmegen has also developed a range of immortalised chondrocyte cell lines also with the aim of isolating pharmaceutically useful compounds. The particular area of focus is inhibitors of cytokine and growth factor activation, which play an important role in OA pathology.

Researchers are keen to explore the potential of this line of research through appropriately structured deals with the pharmaceutical and/or biotechnology sector.

Changes of bacterial community composition in the Bay of Villefranche

The diversity of bacteria and archaea was investigated during a 1.5-year study in the Bay of Villefranche in the north-west Mediterranean Sea.

Sequence information is available for the phylogenetic affiliation of the detected phylotypes. Between 17 and 30 bands (phylotypes) were detected. Using cluster analysis, phylotypes grouped into specific periods such as phytoplankton bloom, *Synechococcus* bloom, summer and fall/winter.

However, this grouping differed for waters above and below the thermocline. Specific phylotypes responded charac-

teristically to short-term changes such as blooms, local upwellings, heavy rainfall, forest fires and Sahara dust depositions. These results indicate that unpredictable short-term events play a significant and previously not sufficiently considered role for sustaining diversity in coastal microbial food webs.

Diversity was not linked to ecosystem functions using conventional analysis

such as multiple regression analysis. However, when artificial neural networks were used, bacterial production and respiration were linked strongly but in a non-linearisable way to bacterial diversity. This suggests a complex pattern between diversity and ecosystem function, which has to be considered in assessing the effects of global change.

A new biohybrid computational platform

Breakthrough advances in the field of neural information processing may only be possible using a microelectrode array (MEA) system based on complementary metal-oxide semiconductors (CMOS), because high spatiotemporal resolution recordings are necessary to completely explore the complex nature of neural information processing.

The microelectronic system design approach in the INPRO project is based on a modular design. Each electrode of the MEA has an associated unit of circuitry including a fully differential band-pass filter for immediate signal conditioning, and a buffer for stimulation and mode selection.

Implementing filters and buffers at each electrode offers the following important advantages in comparison to other CMOS MEAs.
- The signal is amplified and filtered in close vicinity of the electrodes, which makes the design less sensitive to noise, and distortion picked up along connection lines.
- A stimulation buffer makes the stimula-

tion signal independent of the number of activated electrodes.
- The high-pass filter removes offset and slow drifts of the electrophysiological signals and thereby allows for immediate signal amplification.
- The low-pass filter limits the noise bandwidth and acts as an anti-aliasing filter for succeeding A/D-conversion. FPGA-based electronics interface to PC data aquisition and analysis using standard USB 2.0 protocols.

Neurons from primary sources as well as from progenitor cell lines can be cultured on the INPRO chip for several months. Surface

modification by biochemical adhesion and differentiation factors allow the definition of growth areas. The chip can be housed in a microfluidic chamber for nutrient exchange and application of neuroactive drugs.

The INPRO platform has been tested and its functionality been validated using standard approaches and recipes in cell culturing and electrophysiology — demonstrating that upon commercialisation it may facilitate high-resolution investigation of learning paradigms by *in vitro* long-term multichannel electrophysiology without the need of changing well established protocols.

Researchers get neurons and silicon talking

European researchers have created an interface between mammalian neurons and silicon chips. The development is a crucial first step in the development of advanced technologies that combine silicon circuits with a mammal's nervous system.

The ultimate applications are potentially limitless. In the long term it will possibly enable the creation of very sophisticated neural prostheses to combat neurological disorders. What's more, it could allow the creation of organic computers that use living neurons as their central processing unit (CPU).

Those applications are potentially decades away, but in the much nearer term the new technology could enable very advanced and sophisticated drug screening systems for the pharmaceutical industry.

'Pharmaceutical companies could use the chip to test the effect of drugs on neurons, to quickly discover promising avenues of research', says Professor Stefano Vassanelli, a molecular biologist with the University

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of Padua in Italy, and one of the partners in the Nachip project funded under the FET initiative of the European Commission's IST programme.

Nachip's core achievement was to develop a working interface between the living tissue of individual neurons and the inorganic compounds of silicon chips. It was a difficult task.

'We had a lot of problems to overcome', says Vassanelli. 'And we attacked the problems using two major strategies, through the semiconductor technology and the biology.'

With the help of German microchip company Infineon, Nachip placed 16 384 transistors and hundreds of capacitors on a chip just 1 mm² in size. The group had to find appropriate materials and refine the topology of the chip to make the connection with neurons possible.

Biologically Nachip uses special proteins found in the brain to essentially glue the neurons to the chip. These proteins act as more than a simple adhesive, however. 'They also provided the link between ionic channels of the neurons and semiconductor material in a way that neural electrical signals could be passed to the silicon chip', says Vassanelli.

Once there, that signal can be recorded using the chip's transistors. What's more, the neurons can also be stimulated through the capacitors. This is what enables the two-way communications.

The project tested the device by stimulating the neurons and recording which ones fired using standard neuroscience techniques while tracking the signals coming from the chip.

The development of the interface and chip are crucial for this new technology, but problems remain. 'Right now, we need to refine the way we stimulate the neurons, to avoid damaging them', says Vassanelli.

That's one of the problems the team hopes to tackle in a future project. Right now a proposal has been prepared which could tackle this and many other problems, including how to communicate with the neurons using genes.

'Genes are where memory comes from, and without them you have no memory or computation. We want to explore a way to use genes to control the neuro-chip', says Vassanelli.

If Nachip took the first crucial step towards a neuron-powered CPU, future work will pave the way for a genetically powered hard disk.

'Europe is very well placed in this field of research, because it is essentially a multidisciplinary field, and we have multidisciplinary teams working on it', says Vassanelli. 'We also have the infrastructure with institutes like the Max Planck Institute for Biochemistry in Martinsried, which is one of the world leaders in the field. Europe should be very proud of these resources. It gives us access to equipment and expertise that would be very hard to replicate elsewhere.'

Novel x-ray-free diagnosis for scoliosis

*Scoliosis can affect adults and children alike.
The condition is characterised by a side-to-side curvature
of the spine and is quite common in the population.*

The condition is often misdiagnosed especially in childhood; however, a new technology from Italy might offer new solutions to physicians. An Italian SME has developed a new system for the screening of scoliosis. The method is non-invasive, inexpensive and it is not based on the use of x-rays.

This approach utilises a series of reflective tags that are positioned on the patient's back. Following a series of photographs, the digital image is analysed using newly

developed software. The tailor-made software can detect spinal deformities with a 98 % accuracy compared to radiographic methods.

Its low cost and safety render this method suitable for repeated applications for monitoring purposes. It is also suitable for school screenings. All the required components can be easily transported, further facilitating the use of the method. The analysis of the digital images means that the patient is never exposed to x-

ray radiation, thus lowering the overall health risk.

A prototype has already been developed for demonstration purposes and the originators are now seeking to enter into specific agreements to further the potential of this approach. Partners are sought to carry out further technical tests and marketing efforts and to develop local language support if and when needed.

Robots manipulating animal behaviour

A pet dog sits on command, but nobody expects an insect to follow human instructions. So it may come as a surprise to learn that researchers recently succeeded in controlling cockroaches with tiny mobile robots. The results hint at a future where we can interact and communicate with many different kinds of animal.

Little larger than a thumbnail, the cubic insect-like robots or 'insbots' are technological marvels. Developed under the FET initiative of the European Commission's IST programme as the project Leurre, the insbots are fitted with two motors, wheels, a rechargeable battery, several computer processors, a light-sensing camera and an array of infrared proximity sensors.

When dropped into a small experimental area with a maze of curved walls, the robots, built by the project partner from the *Ecole Polytechnique Fédérale* in Lausanne, move, turn and stop. They can navigate their way safely by avoiding the walls, obstacles or each other, follow the walls, congregate around a lamp beam or even line up. When placed in the same area with cockroaches, the robots quickly adapt their behaviour by mimicking the animals' movements. Coated with pheromones taken from roaches, the infiltrator robots even fool the insects into thinking they are real creatures.

The roach pheromones — a blend of molecules developed by the project partner from the *Université de Rennes I*, France — enable various forms of communication, including recognition and attraction. For example, when a roach detects another roach, it may approach it, move away or stop. Cockroaches were chosen here because their pheromones are easier to manipulate than those found on other gregarious insects, such as ants.

According to coordinator Jean-Louis Deneubourg, from the *Université Libre de Bruxelles*, the project had its origins in collective intelligence and behaviour in animal society, as well as the tradition of using artificial agents to test theories about animals. 'Robots have already been used to interact with some animals, such as bees. But they cannot react to the animals' response', he says. 'In our project, the autonomous insbots call on specially developed algorithms to react to signals and responses from individual insects. This results in a chain action or reaction between the artificial and natural agents — a two-way interaction that is unique and very promising for sciences such as biology and robotics.'

Not only did the insbots act like and interact with the insects, they even succeeded in changing the roaches' behaviour. For example, the darkness-loving insects followed their artificial cousins towards bright beams of light and congregated there. This process took up to two hours, but it showed how humans might soon be able to manipulate the behaviour of a whole colony of insects. A trick that would delight pest-controllers the world over!

Two side-projects under Leurre (run by the project partners from Toulouse and Brussels) also looked at sheep and chickens; animals that are happy to follow, in some situations, their 'leaders' — unlike the cockroaches, whose collective behaviour is essentially 'democratic'. The researchers collected data and developed mathematical models describing the collective behaviour of sheep, such as clustering together in a field. These models have yet to be taken up in a follow-on project, but are scientifically valuable. Adds Deneubourg, 'They are a great way of exploring the importance of leadership or collective behaviour in animals, paving the way for people to control animals and even colonies of robots.'

Asked why people would want to influence animal behaviour, Deneubourg offers several answers. Firstly, by changing the way animals behave or inducing collective behaviour, scientists can learn much about animal communication and information processing. Secondly, the ability to create 'mixed systems', where artificial agents interact with natural ones, is a long-held dream for many in the scientific community — including those working on nanotechnology. Moreover, these systems are in keeping with emerging European research such as collective robotics and FET-funded projects such as Swarmbots or Micron.

'We believe farming in Europe can only survive if it is associated with high technology', he adds, pointing to a potential increase in competitiveness and a decrease in costs but keeping in mind animal welfare and natural breeding and conditions. 'A robot interacting with animals, even if it is not mobile, could be used for numerous tasks, such as herding or milking. Our project demonstrates that the fields of biology and IT can work together more closely in future.'

Though the project has officially ended, some of the partners are continuing to refine the behaviour models they developed. The main research results are also being published in leading IT and biology journals. 'Time constraints prevented us from exploring all the new and interesting research paths that opened during the project', says the project coordinator. 'But we succeeded in our main goal — showing that an artificial agent such as a robot can modify the collective behaviour of natural agents, in this case cockroaches, in a mixed community.'

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Bionic fiction becomes science fact

A highly dexterous, bio-inspired artificial hand and sensory system that could provide patients with active feeling is being developed by a European project.

Funded by the FET initiative of the IST programme, the Cyberhand project aims to hard wire this hand into the nervous system, allowing sensory feedback from the hand to reach the brain, and instructions to come from the brain to control the hand, at least in part.

Coordinated by Professor Paolo Dario with Professor Maria Chiara Carrozza leading the development of the hand, the project united researchers from Denmark, Germany, Spain and Italy.

So far, the project is racking up an impressive list of achievements. It has a complete, fully sensitised five-fingered hand. The Cyberhand prototype has 16 degrees of freedom (DoFs) made possible by the work of six tiny motors.

Each of the five fingers is articulated and has one motor dedicated to its joint flexing for autonomous control. It features that miracle of evolution, the opposable thumb, so the device can perform different grasping actions.

Taking inspiration from the real hand, where a muscle pulls a tendon inside a synovial sheath, Cyberhand's finger cables run through a Teflon sheath pulled by a DC motor. So the proximal, medial and distal phalanges, those bones between your finger knuckles, are all driven by the same tendon. This approach is called underactuation as there are more degrees of freedom than degrees of movement (motors); it means the prosthesis has a self-adaptive grasp.

'This is a fundamental feature of the Cyberhand prosthesis because only a limited number of control signals are available for users' voluntary control', says project manager Dr Lucia Beccai. Importantly, it also means less user effort is required to control the hand during day-long use.

The Cyberhand prototype integrates the two types of human senses. One senses where parts of the body are relative to other parts, whether our fingers are open or closed, for example. The other relates to taste, touch, sound, hearing and sight, which tell us about the external world. Cyberhand includes sensors for tension, force, joint angle, end stroke and contact in the final prototype.

This prototype uses longitudinal intra-fascicular electrodes (LIFEs) to connect the hand to the nervous system. Within the Cyberhand project, in addition to traditional wire LIFEs, a new type of electrode has been developed to improve performance and make them less invasive in humans: the thin film LIFE (tfLIFE).

So far, the project has produced excellent science and engineering to create an impressive prototype. The next step is to test the device in humans.

Currently researchers are addressing all necessary medical and ethical issues for implantation in human volunteers. A clinical partner has been identified and the local ethical committee has given the approval for the clinical validation of the Cyberhand system.

Some companies have expressed interest in commercialising the system. Nevertheless, it could be five to eight years before the device clears all the tests necessary to prove its safety, usability, and robustness.

© Cyberhand project

Enzyme research heats up

At first glance, functioning in very hot and very acidic environments may not be at the top of everyone's 'to do' list. However, for a number of microbial species, which thrive at temperatures of 80 ºC, such environments are the norm and their unique microbial profiles are an extremely 'hot' research topic.

The EU-funded Screen project focused on the study of such microorganisms, which belong to the archaea kingdom of *Crenarchaeotes*. Their classification might appear complex but it is important to realise that archaea microorganisms have very little in common with bacteria or fungi, the most common microbes we encounter.

Research on these species is currently receiving increasing attention on a global scale, given their extraordinary properties. *Sulfolobus* ranks among the most well-studied of these; most of the work on *Sulfolobus* has

been carried out across the EU and Screen furthered this European lead.

Microbial members of the *Sulfolobus* genus grow in temperatures of approximately 80 ºC, in very acidic conditions, usually around areas of geothermal activity, such as volcanoes. Their cellular components, such as their enzymes, are of extreme interest to researchers because of their ability to retain their activity in such conditions. This property makes them ideal candidates for a variety of industrial applications, often in very high temperatures.

Understanding the *Sulfolobus* genome therefore would open up a whole new array of biotechnology possibilities. Project partner Copenhagen University managed to derive the complete genome sequences for two *Sulfolobus* species, *Sulfolobus acidocaldarius* and *Hyperthermus butylicus*. Having completed the genome sequencing of these species, researchers are in a position to screen for industrially useful gene products. They have already ascertained that the gene products are highly thermostable and as such could be of interest to a number of industrial partners.

Tracking the pine processionary moth with genetic markers

French researchers have recommended the use of genetic markers as a weapon in the fight to protect Europe's pine forests against the threat of the pine processionary moth.

Global climate change threatens not only the world's weather patterns, but also its ecosystems. For instance, a rise in temperature in some regions could allow the infiltration of new predators.

The pine processionary moth (*Thaumetopoea pityocampa*) is one such example. The pine processionary moth (PPM) attacks pine trees and recent evidence indicates that the range of this predator is in fact growing. Europe's rich pine forests are at risk.

The 'Life quality' programme funded the Promoth project to develop an effective approach to integrated pest management, aiming to avoid or mitigate the ecological damage associated with PPM outbreaks. The *Institut National de la Recherche Agronomique* (INRA), a Promoth partner, proposed the use of genetic markers to provide insight into PPM population dynamics.

INRA identified six independent microsatellite markers associated with varying levels of polymorphism. The markers provide a plethora of information about genetic diversity, gene flow and population traits, allowing insight into issues such as expansion, migration and dispersion. These markers can be exploited by forest managers, local authorities, academics and so forth to shed light on PPM colonisation. Only once the origin of new PPM populations is known can suitable control measures be designed.

INRA published the results of their work in *Molecular Ecology Notes* (MEN) while further technical details can be found in the MENotes and Genbank databases.

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Efficient dairy grazing systems

The efficiency and sustainability of dairy grazing systems have a profound impact on both animal welfare and on economic benefit. This fact poses high demands for good management of grass growth associated with grazing. In this environment, decision support systems (DSS) are required to assist the farmer in grassland management.

Milk production systems, which rely heavily on grazed herbage, need to apply strategies to reduce costs of production and maintain dairy farm incomes in the face of declining milk prices. Grazemore, a major EU-funded initiative, brought together scientists from six European countries to develop a decision support system to help farmers optimise the use of grazed grass in milk production.

The Grazemore DSS was developed for rotational grazing systems with dominant grass species for feeding dairy cows, such as perennial ryegrass (*Lolium perenne L.*) and white clover (*Trifolium repens L.*) swards. The DSS is a large simulation platform displaying the effect of weather conditions on grass growth as well as the effect of variance of management and environment to animal intake and milk production.

With the use of a currently developed herbage growth (HG) model, grass growth can be predicted by measuring and forecasting weather conditions such as air temperature, light and rainfall. Additional inputs such as soil types, fertiliser application and grass species enhance and alter the model output. The paddocks consist of grass with individual growth rates as predicted by the HG model. The paddocks' composition acts as an input for the prediction of herbage intake and milk production from the swards with the use of an herbage intake (HI) model. The DSS performs daily predictions of herbage mass, herbage growth, organic matter digestibility, crude protein and white clover contribution for each paddock. Milk yield and herbage intake are predicted as herd averages for the residence period in each individual paddock.

The DSS allows the biological and economic evaluation of different grazing scenarios under various climatic conditions. This tool significantly aids decision-making concerning issues such as paddock size, time of grazing, grazing order, removing paddocks for silage, rate of fertiliser, ration formulation and other factors, leading to well-managed grassland systems.

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Decision-making for energy systems

As the EU is evaluating a variety of sustainable development and renewable energy methodologies, policy-makers are keen to utilise new tools devised to assist them.

The EU-funded Sapientia project aimed to explore the links between technology dynamics, R & D activities and technological developments. The main focus was placed on energy system analysis and medium- and longer-term technology prospects in the field of energy generation.

The Energy Research Centre of the Netherlands devised methods for multi-criteria decision analysis (MCDA) in this area. MCDA essentially represents a structured approach to decision-making based on a subjective classification of all alternatives. The steps that formed the backbone of this approach were the definition of criteria and a comprehensive literature study on available MCDA implementation texts.

Defining the criteria that would be used for the final decision in terms of technology suitability is a very important aspect of this approach. Furthermore, the literature survey that was carried out yielded interesting results in terms of other analytical methods that have been used in energy policy-making in the past. The application of MCDA can be very beneficial given that it takes into account a variety of factors, therefore leading to more informed decisions.

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Researchers are keen to form links with interested parties and stakeholders in order to develop this line of investigation. The end result could be a versatile tool suitable for use by policy-makers and industrial actors active in the area of energy system analysis.

Modelling wind power

Wind power is increasingly introduced to electricity markets that are currently undergoing a process of market liberalisation. This has a strong impact on both the technical operation of the electricity system and the electricity market.

The integration of substantial amounts of intermitting renewable power production such as wind power in a liberalised electricity system causes chain reactions in technical and economical power system performance. Technical instability can result from transmission bottlenecks between various regions due to increased wind power generation. Economically, these changes in system operations have cost and consequently price implications.

The analysis of the impact of introducing significant shares of wind power in an electricity system requires the modelling of the stochastic behaviour of wind generation. The Wilmar project investigated these strains and problems and developed a modelling tool to analyse the integration of renewable power technologies into existing power systems. More specifically, the modelling tool investigates the wind integration ability of large electricity systems with substantial amounts of power trade in power pools and system stability issues. In this way, it provides a strategic planning tool, which provides a firm basis for decision-making in the power pools.

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A user shell implemented in an Excel workbook controls the Wilmar planning tool. All data is contained in an Access database that communicates with various sub-models through text files that are exported from or imported to the databases. The joint market model (JMM) constitutes one of these sub-models. The JMM output database stores the results of modelling runs and contains forms and queries to present the data. The comparison of different cases is carried out through queries, designed so as to minimise the time needed to retrieve information from the tables.

The most important data can be shown graphically using a set of forms from the database such as forms for electricity prices, wind power forecast versus realised wind power, power production distributed on fuels and production with consumption and transmission.

The Wilmar planning tool, which comprises part of the output database, offers the means for analysis of wind power integration subjects. Collaboration with research institutions and consultancy companies is now sought for further development and use of this tool.

Fuel cell assessment driving the auto industry

For fuel cell technology to become a viable source of energy for the vehicular industry, it is necessary to understand its performance and value under a great many variables.

It is not enough to know how fuel cell technology performs under controlled or laboratory environments alone. The huge variability of the auto industry, for example, demands a comprehensive analysis of the performance of fuel cells for the wide variety of vehicular categories and assorted operational conditions.

Performance values, however, need extensive assessment, and such was the intention of the EU-funded project FUERO. The primary objective of FUERO was to deliver component technologies and advanced systems for fuel cell applications within the auto industry.

The two-phased project evaluated alternative fuels and analysed and defined component specifications according to different system architectures. These specifications were given to manufacturers to develop system integration within the second phase of the project.

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While the project undertook the evaluation of components and their performance, it was also necessary to evaluate the performance of fuel cell technology in comparison to conventionally powered vehicles. The burning question the researchers wanted answered was whether fuel cell technology could successfully replace conventional vehicles and provide the same level of performance satisfaction consumers demanded.

Their assessment proved favourable, showing that in the long term, fuel cell technology could provide more than adequate replacement for conventional vehicles. However, various considerations such as technical challenges, high prices and infrastructure problems are likely to prohibit its short-term implementation.

Yet with regards to fuel efficiency a number of fuel cell types were explored, providing valuable results. Hydrogen in combination with fuel cells has been identified as a means of overcoming dependency on oil-based fuels while simultaneously reducing air pollution and climate change.

Overall, the FUERO project identified valuable technical solutions, performed state-of-the-art assessments and distinctly highlighted the benefits and bottlenecks involved in the adaptation of fuel cell technologies.

Biomass and pyrolysis product characterisation

Biomass is considered to be one of the most promising renewable energy sources. In the context of the Bioelectricity project, the pyrolysis oil produced from biomass is used for the efficient production of hydrogen and electricity.

The production of hydrogen and electricity from biomass is accomplished by reformation of bio-oil in fast pyrolysis processes. Pyrolysis oil concentrates most of the energy of biomass and is used for the production of electricity and heat in small-to-medium size stationary applications. This is achieved by using molten carbonate fuel cells (MCFC), which are hydrogen-utilising fuel cells.

Although the conversion of biomass into pyrolysis oil has been developed to a mature stage, the new products can be potentially harmful and with a variable energetic content. For this reason they have to be assessed before large-scale use. In this direction an analytical method of characterisation of biomass and pyrolysis products has been developed.

Three types of biomass have been chosen as representative of different kinds of feedstock for fast pyrolysis: herbaceous energy crops (switchgrass), woods (beech) and residues (pine sawdust).

The feedstocks resulted in quite different morphology and chemical composition. Switchgrass had the higher content of organic extractives and ash. The content of calcium in beech was relatively high while pine sawdust had the highest content of cellulose, to which corresponded a relatively low content of xylose. Beech wood had the highest calorific value.

Moreover, the respective three pyrolysis oils produced from chips of beech wood, pine sawdust and switchgrass obtained by fast pyrolysis have been investigated. The thermal behaviour, the elemental compositions and the water solubility have been studied both between the oils and in comparison with the starting biomasses. It has also been concluded that viscosity is the most sensitive parameter affecting ageing. The three oils showed different behaviours on ageing, with switchgrass showing the least favourable.

The analytical method for biomass and biofuel characterisation may comprise a valuable scientific and technological input to potential producers. The developed methods could help in obtaining future energy sources.

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Defining solid biofuel standards for Europe

The BioNorm project funded under FP5 brought together nearly 40 participants from across Europe to address standardisation issues related to solid biofuel.

Solid biofuel includes wood chips, sawdust, charcoal, straw, plant remnants such as corn cobs and even solid municipal waste. Biofuel is a renewable and environmentally friendly source of energy. However, one of the obstacles standing in the way of broader adoption of biofuels is the lack of standards.

The Austrian Research Institute for Chemistry and Technology (OFI), member of the BioNorm consortium, tackled the issue of standardising the determination of sulphur, chlorine and nitrogen content of solid biofuel. Excess sulphur and chlorine cause premature corrosion of power plants burning solid biofuel and hence increase maintenance costs. Nitrogen and sulphur emissions to the atmosphere promote aerosol development that negatively impacts visibility and can lead to acid rain.

OFI first focused on the requirements of sample preparation and found that a particle size of less than 1 mm is sufficient. Samples sizes must be adjusted in order to fall within the range for which the analytic instrument is calibrated. As a guide, a sample size on the order of 1 g is usually sufficient.

A number of different elemental analysis methods were evaluated by OFI for each of the three elements. For samples with ample amounts of sulphur and chlorine, combustion with an oxygen bomb followed by quantification of the resulting sulphate and chloride particles is suitable. The advantage is that this procedure is already standardised at the European level. However, this is not adequate for samples with very low concentrations of sulphur and chlorine, for which other methods must be identified.

In the case of nitrogen, automated analysers proved equivalent to the widely accepted Kjeldahl method. No differences were detected among the various methods employed by each analyser; therefore no specific recommendation for a reference method is made. Rather, the key issue turns out to be standardisation of the calibration and operation procedures.

OFI's work in BioNorm will contribute to the development of CEN TC 335 'Solid biofuels'. The institute also identified the need to address other elements, namely bromine and iodine, in a similar fashion.

Advantages of split blade design in wind turbines

A new wind turbine blade was designed by Greek engineers specifically for application in mountainous areas. The split blade design maximises energy output while minimising manufacturing, installation and maintenance costs.

Europe has set ambitious targets for boosting energy production from renewable energy sources by the year 2010. Unfortunately, adoption of renewable energy solutions has been slow across the continent.

Wind farms have been implemented along Europe's northern and Scandinavian coastline with success, but the mountainous regions of southern Europe remain relatively unexploited. The Megawind project was undertaken in order to address the special requirements for wind turbines in such areas.

During Megawind, mechanical engineers from the University of Patras in Greece designed and tested a new 30 m wind turbine blade. The Greek engineers went beyond conventional blade design and created the first-ever megawatt scale split blade. The advantage of the split blade design is that more energy can be generated, especially in high winds. In order to overcome the additional stresses, the blade was reinforced with carbon fabric in critical areas.

During the project an algorithm was invented to optimise blade characteristics, such as blade area and thickness, in order to maximise annual energy capture (AEC). AEC is a measure of the total electricity that can be generated by the system over a period of one year. The algorithm was used to analyse nearly 200 blade types.

A full-scale model was tested during Megawind according to international standards defined by the International Electrotechnical Commission (e.g. IEC 61400-23). Measurements on system components such as joints provided insight into fatigue and expected lifetime issues.

Additional advantages of the new design are that manufacturing time and costs as well as transportation costs are reduced. The modularity of the system makes on-site assembly feasible in remote, mountainous regions and also serves to lower maintenance costs. It is expected that these benefits will help drive the uptake of wind energy in these areas.

ENERGY

A day in the sun for photovoltaic energy

Renewable energy sources have been the focus of intense research on a global scale for a number of years. The EU-funded PV-EC-Net project analysed and studied EU-wide research initiatives in the area of photovoltaic solar energy.

The aim of the project was to successfully coordinate research efforts and thus increase efficiency. A number of key issues, including environmental and large-scale implementation considerations, were taken into account.

Project partners carried out a specific analysis of the key issues affecting European photovoltaic research and its potential in the coming years. These issues included industrial activities and communication as well as energy policies, market development and raw material availability.

The strengths and weaknesses relate particularly to matters inherent to the research community itself, such as R & D activities, research challenges and others. There are specific opportunities to be exploited within the market, given the positive environmental profile of photovoltaic solar energy. This social acceptance has facilitated national support at many levels and continues to do so. It is also extremely beneficial for industry.

The technology and market analysis that has been produced as a result of the efforts of partners is now copyright protected and could constitute a valuable tool for entry into this sector. The project participants are keen to develop collaborative links with interested parties in an effort to exchange information on photovoltaic programmes and develop new strategies and policies.

Rhodium catalyst produces more hydrogen

A rhodium-based catalyst produced in Cyprus has been shown to be far superior to today's commercial catalysts in producing hydrogen gas from biomass.

Catalysts work chemical magic by increasing the rate of reaction. They play key roles in a number of industrial applications. Chemists from the University of Cyprus with extensive experience in catalyst development set their sights on phenol reformation and hydrogen gas production from biomass conversion.

The university researchers moved beyond traditional nickel catalysts and experimented with rhodium-based catalysts. Furthermore, the catalyst was formed using the sol-gel technique, which transforms liquid constituents into solid form, as opposed to the more conventional process of wet impregnation.

The Cypriots put the new rhodium catalyst to the test, converting feed gas containing 0.5 % phenol over a broad temperature range (575–730 °C). Amazingly, the rhodium catalyst was able to produce 50 times more hydrogen than its commercial nickel counterpart. In particular, it outperformed the nickel catalyst at low temperatures.

Furthermore, the rhodium catalyst was able to maintain nearly constant rates of hydrogen production across the entire temperature spectrum. Its performance was also extremely stable over time. Based on these very positive results, the University of Cyprus is pursuing a patent for the new catalyst.

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Energy's cost assessment

An EU-funded project is studying just how expensive the price tag of future energy R & D will be.

Whether Europe's energy R & D programmes are viable enough to be competitive is far from easy to answer. Given the complex nature and integration requirements of novel, hybrid renewable energy sources, a comprehensive insight based on workable cost-effective modelling software would require both insight and sapience.

With the current, global situation on energy production, solving these problems before things worsen is imperative. R & D have, quite literally, got limited time in which to provide competitive, affordable and suitable energy solutions.

Therefore, critical assessment tools that provide answers for policy-makers as to the financial costs involved are essential. Such was the intention behind the Sapient project funded by the EU. To validate the modelling, the project conducted sensitivity testing in the solar photovoltaic and wind energy sectors.

The analysis was conducted in a rather unusual manner: assessing the choice of the 'wrong' approach, i.e. that of learning by doing, rather than learning by research. To further focus the testing, an aggregate or stylised approach elaborating on a full-scale assessment of energy strategies as a means of evaluating energy and the environment was adopted.

As a result, a credible dataset was established for compiling accurate costs relating to capacity installation and R & D budgeting (private and public) for current and future energy options.

New fuel cell technology expands possibilities

Shifting European energy demands towards alternative energy sources is not a simple task. The technological needs involved in this undertaking are partly tackled by the EU-funded Apollon project.

Apollon project partners set out to develop novel polymeric fuel cells which would operate using hydrogen and/or methanol fuels. The main aims were the production of effective electrode materials and cheap polymeric electrolyte membranes (PEM). One of the overall objectives was that new materials would allow the fuel cells to operate at temperatures above 150 ºC.

PEM fuel cells can deliver high power density and operate under mobile and stationary conditions. The new technology developed within the framework of the Apollon project would allow PEM fuel cells to be more flexible in terms of applications and temperature ranges. Catalysts form an important part of all PEM fuel cells but are also a consider-

able limitation in terms of their sensitivity to environmental conditions, such as temperature and carbon monoxide levels.

Developing new catalyst materials was one of the first steps towards the development of innovative PEM fuel cells. Researchers applied a nanoparticle colloidal method for catalyst preparation. This new route resulted in catalyst materials with a much improved thermal stability.

The colloidal nanoparticles can be readily dispersible in various solvents and the resulting colloidal catalyst can take on a desired set of characteristics

depending on researchers' specifications. The 'precursor concept' for the synthesis of colloidal catalysts developed within Apollon allows flexibility in designing catalyst properties, which is beneficial in terms of production.

Funded under the FP5 programme EESD
(Energy, environment and sustainable development).

Collaboration sought: further research or development support.

Offer ID: 2572

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Shedding light on solar cells

Solar cells are used in order to convert solar radiation into electrical current. The conversion efficiency is highly dependent on the material quality and the capabilities of the processing technologies available. Consequently, scientific research tries to bring advancements in these areas, while at the same time keeping the cost low.

The competitiveness of solar cell technology in energy production is strongly dependent on its price. Rapid thermal processing (RTP) directly addresses the issue of fabrication costs by reducing the processing time in comparison with conventional furnace processing. In this way, the throughput is improved while high cell efficiency is maintained. However, there are some major concerns related to wide industrial applications of RTP in solar cell production. The FLASH project aimed at developing an industrial RTP system adapted

to photovoltaic cell production that will be applicable to all main thermal steps in the fabrication of solar cells.

Towards this objective, the FLASH research group had a systematic view of the influence of ultraviolet (UV) radiation on the diffusion process in silicon in the wafer surface. The fundamental investigation has been executed in a prototype reactor equipped with additional excimer lamps that allow the switching on of these UV lamps inde-

pendently from the conventional lamps. The comparison between samples that were processed with additional UV light and those processed with the normal spectrum of the RTP lamps was performed for identical processing temperatures.

The excimer UV lamps were located above the wafer and emitted at a wavelength and with a power density sufficient to observe UV-enhanced diffusion, as claimed in relevant publications. However, this UV-enhanced diffusion did not occur, indicating that other diffusion mechanisms must be explored.

Funded under the FP5 programme EESD
(Energy, environment and sustainable development).

Collaboration sought: information exchange/training.

Offer ID: 2600

Combined tidal stream/reversible hydrogen system

A Scottish university in conjunction with another university in the United Kingdom has developed a combined tidal stream/reversible hydrogen system for balanced renewable generation. This technology is being offered for licence or technical co-operation.

Tidal generators present a useful energy source, but suffer from the variation in power produced as the tides move in and out. The change in direction of flow also requires the generators to be bi-directional. A method is needed to store some of the energy produced during peak flows and released during low flows.

A robust generating device is needed for this harsh environment, coupled with a

low-maintenance power storage device. This new combined tidal stream/reversible hydrogen system for balanced renewable generation technology meets these requirements.

By coupling the generators with a reversible fuel cell to store the spare energy as hydrogen gas, to be used later when needed, the reversible fuel cell should have good

efficiency and reliability, as there are no pumps etc. to use power or break down. It is also a simple, compact unit with the ability for easily extended capacity or power independently.

Innovative aspects: generates constant power from tidal sources;
small, simple system; robust reversible fuel cell system;
simple and effective generation platform.

Promoted through the IRC network.

Potential market applications:
hydrotechnologies, waste heat recovery.

Collaboration sought: further research or development support,
information exchange/training, licence agreement, other.

Result ID: 40746

Exploiting sugar waste for biomass production

A highly yielding production process allows bioethanol generation from sugar waste or energy crops using the same equipment.

Biomass constitutes one of the key sources of renewable energy and includes almost all plant or plant-derived material for generating fuels, power, chemicals, materials and other products. Of particular interest is its use for bioethanol, which can be used as an alternative liquid fuel. Furthermore, it can be derived from sugar, using what is considered to be a viable conversion technology. Biorefineries are used to biologically process sugar into ethanol.

The newly developed process produces bioethanol from various types of sugar waste. Aided by a diffusion extraction system, continuous processing takes place and is followed by compressing the damp wastes. The next step involves preparation of the sugar juice to optimal fermentation with selected yeast. The complete process can be optimised through automation, thus reducing production costs while increasing the quality of the end product.

Raw materials cover a wide range of sugar waste including starch, Jerusalem artichoke, waste sugar juice, and others. Apart from ethanol, other products that could be generated are sugars, such as insulin, or fructose. According to the end product, the process can be easily modulated to run under different parallel lines with the same equipment. This considerably reduces the cost and significantly increases the range and benefits of the products.

For the purposes of demonstration a pilot plant has been built that could be easily adapted to any modifications such as the extraction of natural products, and the alteration of control parameters and their parts. The generated wastes coming from the production of bioethanol could be used for covering the energy requirements of the process. A technical co-operation or commercial agreement with technical assistance is sought with partners involved in food, sugar or bioethanol production.

Promoted through the IRC network.

Collaboration sought: marketing agreement, information exchange/training, other.

Offer ID: 2634

Technologies to improve offshore wind farms operation

A university in London has developed technologies for the maintenance and operation of offshore wind farms.

The technologies allow improved transmission of electricity between the offshore site and the shore. They also offer knowledge transfer for the assessment of offshore wind farms maintenance strategy. The university is seeking companies and research institutions interested in partnering for further co-development of these technologies.

The university has expertise in the development of technologies to improve the feasibility of offshore wind farm projects in terms of their operation and maintenance, and the high power transmission from the offshore generating sites to shore. The operation and maintenance of offshore wind farms is significantly more demanding and more expensive than equivalent onshore wind farm projects. The selection of the appropriate maintenance strategy and operational management is key to the feasibility of the business. The research group offers knowledge transfer for assessing operational strategies and providing technical assistance to optimise the strategies.

The group has designed a wind farm support vessel consisting of a low-draft crane vessel with jack-up stabilisers designed to provide support to the offshore farms. The vessel, capable of a maximum speed of 23 knots, transports maintenance teams to offshore wind farms together with their equipment and spares, including turbine blades. The vessel has accommodation for 24 personnel and is able to support all the maintenance required on a wind turbine, including blade changes, for periods of up to 28 days.

The research group develops technologies to improve the transmission of electricity from the offshore generating sites to shore. The group has carried out studies of the performance of different types of offshore power transmission methods in order to advance the design of offshore power cables. It also has technology to optimise the performance of the cable risers used in the offshore. These cable risers can face problems in interconnecting floating platforms with shore-based electrical distribution systems. Unlike static high-voltage cables laid on the seabed, dynamic cable risers are subject to movement both from the surface generating vessel, from vortex-induced vibration and water movements. Their technologies improve, for instance, the cable's resistance to insulation cracking, which may result from such movement.

Main advantages:
- multidisciplinary team;
- experience in collaboration with multi-national teams;
- experience in participating in EU framework programmes.

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Innovative aspects: novel ship design solutions implemented in the design of a wind farm support vessel; optimisation of the high-power cables to optimise the quality of the transmitted electrical waveforms; development of dynamic cable riser for offshore use; designed improvements in the electro-mechanical performance of high-power cable risers to develop new applications for the offshore dynamic environment.

Promoted by the IRC network.

Potential market applications: manufacturing technologies, wind energy.

Collaboration sought: information exchange/training, other.

Result ID: 40129

New crop of technology reveals plant health

Green-fingered amateur gardeners often talk to their plants; now the plants can talk back. Scientists have developed a system that picks up the subtle cues of plant communication helping plant growers to monitor the crop's state of health and will result in optimal environmentally friendly growing conditions.

Funded under the FET initiative of the European Commission's IST programme, the Plants project sought to develop a unique system that linked plants, technology and people to continuously assess the state of crop health. Using sensors, transmitters and specialist software, the system monitors the state of the crop on a plant-by-plant basis, in near real time.

Dr Anthony Morrissey at Tyndall National Institute (Ireland) led the project which included partners from University College Cork (Ireland), Computer Technology Institute (CTI, Greece) and Eden Project Ltd (United Kingdom).

'You could almost walk away from the crop and let it grow on its own', says Dr Fiona Tooke of the Eden Project, a unique public education facility in the United Kingdom's Cornwall region that gathers all the planet's major agricultural systems under a series of spectacular, and immense, plastic domes, which function as high-tech glasshouses. Eden joined the Plants project to help promote and disseminate the ideas and philosophy behind the project.

The combined presence of plants and artefacts in an environment inhabited by humans set a new computing environment, where the complexity of the interactions between many possibly heterogeneous artefacts and their environment, including plants and humans, could be overcome by developing a technological framework (i.e. system architecture, models and tools) for composing the so-called ubiquitous computing applications.

The Plants project adhered to a broader vision where the virtual (computing) space was seamlessly integrated with the physical environment. One of its main objectives was to develop the necessary software modules, tools and methodologies that enable the efficient and flexible integration of 'augmented' plants and artefacts into ubiquitous computing applications which may range from domestic plant care to precision agriculture.

To bring this vision closer to reality several issues were addressed and resolved:
- software infrastructure for pervasive computing that can support the integration between our physical space and virtual computing space;
- sensors and sensor network that can capture and disseminate context information;
- context-aware applications that use context information to create intelligent artefacts and applications;
- embedding computing into physical entities;
- user interfaces for supporting ubiquitous computing.

'The system picks up on the plants' signals that indicate when plants need help, such as more water, more nutrients or more or less light. Essentially, the plants are controlling the system', says Tooke.

'The main idea behind Plants is to develop a system that produces the optimal growing conditions for a crop, so that crops are kept in the best possible health with the minimum of inputs', she continues. 'It promotes sustainability, because there isn't excessive use of inputs like fertiliser and water. It makes crop

management more economic too, as well as less damaging to the environment.'

The system uses an infrared camera to scan the entire crop canopy. It can automatically detect when individual plants or groups of plants are getting too hot. Another sensor detects chlorophyll fluorescence, which tells the system the rate at which the plant is absorbing energy. That reflects the current state of photosynthesis, itself a reflection of the plant's health. The team at University College Cork is evaluating other sensors in a future project.

These sensors communicate their data through specially developed wireless transmitters. The transmitters started out as a field-programmable gate array (FPGA), a sort of universal microchip that can be set to carry out many different functions. Over the life of the project, however, scientists at project partner Tyndall National Institute in Cork managed to reduce the essential technology from 100 mm FPGAs to a specialised 25 mm module. They believe it will be possible to reduce it to a mere 10 mm cube utilising the latest system integration technologies under development at Tyndall.

This system incorporates a wireless transceiver capability with embedded protocol software to minimise power consumption and maximise data throughput. This can work in conjunction with high-specification FPGA technology for signal processing tasks. Additional input capability for sensor and actuator integration can be incorporated seamlessly due to the modular nature of the system. This gives it the ability to interface to a broad range of physical and chemical transducers. The total system is packaged in a modular 25 mm^3 form factor developed at Tyndall. This enables the module to be utilised in a wide variety of projects incorporating a multitude of actuators/sensors in miniaturised, mobile, autonomous systems.

© Plants project, 2006

'New crop of technology reveals plant health'

What's more, these chips work wirelessly and contain their own batteries. They can communicate over large distances for their size, with a current range of about 10 m, but again the Tyndall team hope to push their range further. Finally, they are also 'looking at the potential of "power harvesting" for the chip, where it would supply its own energy needs through solar energy or ground vibrations, making the chip completely independent', says Tooke.

She believes these could have many applications outside of the Plants project. 'We were speculating, for example, that they might have an application in hostile environments, like growing plants in space or soil-less systems. Potentially, these are situations where our system could prove very useful.'

The sensors and transmitters are two key elements of the system, but its heart is the management software, designed by Computer Technology Institute, Greece, that gathers, and then acts on, the data operating as a plant/environmental context management system. Called ePlantOS, it can control the deployment of water, nutrients or pesticides, as necessary.

ePlantOS provides an interface with sensors and actuators, maintains a plant-specific ontology and supports distributed resource management with local and/or global decision-making according to criteria. ePlantOS is a middleware system operating according to a peer-to-peer interaction model in which plants being monitored and devices of the system are universally modelled. A modular design allows the replacement of a module without affecting the functionality of the rest provided that the interfaces between them remain consistent. The system incorporates a mechanism for learning rules or parameters to be used in the decision-making process, according to historical/logged data.

A set of graphical tools provide the user with a set of useful operations such as creating, composing or reconfiguring applications which may range from domestic plant care to precision agriculture, viewing knowledge represented into the Plants ontology, monitoring the plant and environmental parameters and finally managing dynamically the rules taking part in the decision-making process.

Plants developed two demonstrators, one at the beginning of the project in 2003 to prove the concept. The second demonstrator went live at the Eden project end of March 2006 and was the cen-

tre point of a special workshop to introduce the technology to experts in the fields of plant science, crop management, microelectronics and software engineering. A temporary exhibit was then organised to display Plants results from mid-April to end of June 2006 at the Eden project.

The team designed the current system to track high-value glasshouse crops such as strawberries and other soft fruits, but a commercial version could be tractor-mounted to survey field crops and, as the costs of production come down, it may be possible to deploy it in comparatively low-value crops, too.

As well as improving the system, as it exists now, by further miniaturising the equipment, the team also hopes to develop other sensors in a future project. These could look at the levels of volatiles, gases that plants emit when they are under stress. For example, the presence of methyl jasmonate shows the plant suffered a wound, typically from a pest, while plants release methyl salicylate in response to disease, such as a fungal attack. Tracking these gases would allow farmers to deploy pesticides or other remedies when necessary.

'Unfortunately plants emit such small doses of these gases that they are difficult to detect with current sensor technology, but scientists at University College Cork are looking at this area and it may be a part of some future system', says Tooke.

Three partners lodged a patent for the technology developed during the Plants project. 'They certainly hope to carry the work further, by initially developing a prototype, and then possibly commercialising the system', says Tooke. 'That work will go beyond the life of this project, however. Plants ended in March 2006.'

'Moving our research effort even further, towards a more autonomous system in the long term with self-adaptation and self-learning characteristics, we aim to explore ways of incorporating artificial intelligence/machine learning aspects in the system', she says.

None of those system improvements will make the plants totally stress-free, but if the project's crop management system takes off, at least their complaints will be heard and listened to.

Marine ichtyoplankton collecting tool

A French SME specialised in marine ichtyoplankton collection, recognition and rearing has developed a specific tool that is able to collect some 100 larvae per trap per night.

The SME has developed a specific post-larval collecting tool: the 'Collection by artificial reef eco-friendly' (CARE) trap. This tool can also be used to assess coastal environment health, as post-larvae are a useful bio-indicator.

The company has developed highly skilled knowledge in plankton collecting (mainly ichtyoplankton from coral reefs and benthic demersal species), sorting and preservation. In addition to these three central activities,

the company could bring its technological know-how to laboratories or private companies which need to collect larvae from natural environments, study fishing stocks, or seek alternative species for aquaculture.

This technology could be applied to four main activities:
- restocking damaged or over-fished reef (or artificial reef) and boosting the recovery of marine protected areas;
- raising eco-friendly aquarium fishes

from identified larvae coming from fish plankton;
- fish growing for local food-fish aquaculture income;
- scientific studies: fishing- and mariculture-specific prospective, biodiversity, environmental studies, etc.

Innovative aspects: this tool acts like an artificial reef and is able to collect close to 100 larvae per trap per night when displayed in an appropriate area; 10 CARE units can be chained and settled on the same spot; the trap does not damage the larvae or the habitat.

Potential market applications: animal/plant breeding.

Collaboration sought: information exchange/training.

Result ID: 40342

ENVIRONMENT

Guidelines for avalanche protection dams

A handbook on the various types of avalanche protection and their basic functions of operation has been designed.

With a view to the sustainable development of European mountain ranges, an emphasis has been placed on improving the physical basis of dynamic avalanche models. More specifically, concern is placed on modelling flow regimes and the rate of snowfall entrainment and suspension.

The impact models have been validated via measurements at full-scale dams. Additionally, partners have collaborated to disseminate results in the form of handbooks and courses in order to help ensure more confidence in countries facing the threat of avalanches.

One such handbook in particular looks into deflection and catching dam design. It essentially presents various kinds of protection dams and their fundamental principles of operation. The knowledge obtained from lab and full-scale experiments was used for the analysis of the virtues and defects of novel dimensioning criteria. Then the findings were critically compared to those of traditional methods.

As a result, recommendations for assessing the suitability of various types of dams in a particular situation as well as the overall design of the dam are provided. Also several examples are used to illustrate the main points. Users of the handbook are invited to share their experience with the authors in regard to the design procedures and dimensioning criteria presented in hope of improving future editions.

Protecting Europe's fish against endocrine disruptor compounds

The faster one can detect harmful levels of pollutants in water, the faster one can respond to protect the ecosystem's residents. Researchers in Italy exploited liquid chromatography-mass spectrometry (LC-MS) to provide concentration data for endocrine disruptors in a very short period of time.

Endocrine disruptor compounds (EDCs) are manmade chemicals released into the environment that wreak havoc with organisms' endocrine systems, negatively impacting their development and reproduction.

The EESD programme brought together seven European universities to address the effects of EDCs on Europe's fish resources. The ACE project examined the effect of a specific type of EDC, oestrogenic chemicals, in complex mixtures.

Environmental chemists with the University of Venice contributed by significantly shortening the amount of time needed to analyse water samples for EDCs. They employed the LC-MS technique that allows for separation and quantification of several different chemical species simultaneously.

In comparison to conventional analysis techniques, which require 6 to 8 hours per sample, the LC-MS technique requires less than 15 minutes per sample. In addition, high sensitivity can be attained. Method detection limits for carboxylated nonylphenol monoethoxylate and nonylphenol monoethoxylate are 0.03 µg/l and 20 µg/l respectively.

Application areas for the technique include oestrogenic assays in polluted water or wastewater streams. The technique also works with saltwater samples. In addition, the scientists stated that the method could be employed to measure levels of other harmful chemicals.

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Studying the effects of noise pollution on children's health

A study of exposure-effect relationships of chronic aircraft noise, road traffic noise and a combination thereof in regard to the health of children residing around major airports has been conducted.

Noise pollution for aircraft and road traffic has caused children to be at high risk of adverse effects to their cognition and health. Some of these effects include annoyance, stress-related psycho-physiological effects, impaired cognitive function, raised blood pressure and sleep disorders.

In an effort to alleviate these conditions, the RANCH project studied the exposure-effect relationships of chronic noise pollution on the health of 9-to-10-year-old children living near major airports in Spain, the Netherlands and the United Kingdom.

The children were chosen to take part according to the level of external noise exposure at school and they also completed a questionnaire about aircraft and road traffic annoyance both at school and at home. Blood pressure samples were also taken.

Data from the three countries was collected and examined via multilevel modelling that permitted data at both the school level and the individual level in one model. The analysis was adjusted according to various demographics and additional adjustments were made for noise annoyance and blood pressure.

The results of the study produced several key findings in understanding the exposure-effect relationships of chronic aircraft and road traffic noise exposure on the health of children. The results should be useful in possibly alleviating such adverse effects in the future.

Fraxinus populations in focus

Science-based guidelines that assist forest managers aiming to select sustainable seed sources for European **Farinas** *species are now available.*

Planting and managing woodlands for conservation and environmental benefits has raised numerous questions about source seed selection. The enrichment and restoration of existing forests by means of natural regeneration require trees with good reproductive vigour, ability to compete with other species and adaptive capability to future environments. Nonetheless, local genotypes are assumed to be well adapted to local conditions. As a consequence, limited scientific basis exists for the selection of non-local planting material genetically appropriate for the maintenance of diversity and sustainability.

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The Fraxigen project focused on principal European *Fraxinus* populations and aimed to provide a set of scientifically based guidelines for anthropogenic selection of sustainable ash genetic resources. For this purpose, researchers at Oxford Forestry Institute investigated genetic diversity in autochthonous populations of ash, as well as forces shaping this diversity. These studies included reproductive biology, mating system and gene flow in *Fraxinus*.

To estimate genetic diversity within populations and the extent of differentiation between them, a set of laboratory-based genetic studies complemented a series of field trials within semi-natural woodland. Phenological observations and controlled pollination experiments looked into each species' potential for self-fertilisation, in addition to the potential of different genders as pollen and seed parents. The findings were translated into scientifically based recommendations for sourcing of ash seed for the three species under study (*F. excelsior, F. angustifolia, F. ornus*).

Seed collection requires a broad genetic base to ensure trees will be able to produce seeds in the short term and adapt to changing environments in the future. The most important aspects identified for maximum genetic diversity are the number of trees collected from, spacing between them and the amount of seeds collected. High levels of gene flow and broad adaptability within the European *Fraxinus* species stressed broad seed source and the collection increased distances between seed trees.

The recommendations drawn for long-term conservation of these species in Europe are expected to provide guidance on forest management for governments, the private sector as well as public interest groups.

For a safer design of FPSO vessels

As the oil and gas industry is increasingly developing fields offshore, floating production, storage and offloading (FPSO) vessels are constantly gaining importance.

As experience with the current FPSO fleet grows, it has been acknowledged that there are fundamental differences in the way they are operated compared with other types of floating structures. It is not surprising that many aspects of their designs fall outside traditional rule-based and perspective approaches, since they are becoming more complex and require novel installation configurations. For several issues concerning design assessment and structural reliability in extreme sea wave conditions, integrated efforts have been directed towards an accurate probabilistic description of the environmental loads.

Within the Rebasdo project, risk-based methods, widely used in other industries, have been introduced for the structural design and safety assessment of FPSO units, including their mooring and riser systems.

In addition to the potential consequences of extreme environmental loads, these methods aim at determining the potential frequency and severity of extreme events, which are measurable by advanced environmental modelling.

Scientists at Imperial College introduced a novel approach to the modelling of extreme waves inconsistent with standard statistical analysis. For the calculation of wave crest elevation statistics, instead of a linear or second order non-linear approach, a fully non-linear numerical model was proposed in unidirectional (2D) deep-water sea states. The results indicate that locally long-crested sea waves could provide a rational basis for explaining the formation of extreme waves.

The next step was to combine the derived short-term statistics of extreme wave parameters with long-term statistics of storms calculated from field observations. This allowed prediction of the frequency at which extreme wave conditions can be expected with a high degree of accuracy.

These findings are expected to contribute to the synthesis of guidelines for the specification of the environmental loads. Appropriate factors of safety for the given loads could subsequently be derived for the engineers for inclusion in design checks of offshore structures and their mooring systems.

Researchers are seeking collaborative parties in an effort to exchange information and establish a more direct relationship between design and a certain level of structural reliability of offshore installations.

New results on bacterial degradation in wood

New findings on bacterial degradation may help to improve preservation of wooden archaeological and cultural heritage sites.

New findings reveal that bacterial degradation is a major threat to the wooden cultural heritage located in water or in soils.

As a result of this research it is now known that if wood is well conserved, it can last centuries and retain its strength. However, in the presence of fungal activity, bacterial wood degradation will be more aggressive, an issue believed to be underestimated in Germany, Great Britain and Italy.

The research found that foundation piles that have been in service for approximately 100 years and are situated below ground-water level show indications of bacterial decay. This decay begins in the outermost layer, where it was most commonly found, before it works its way towards the centre.

The study revealed that certain timber species used for piles were more resistant to decay than others. Spruce appeared to be more resilient to bacterial degradation than pine sapwood or alder. Pine heartwood also appeared to be quite resistant.

Despite the resilience of certain timber species, location also played a critical role in the development of bacterial degradation.

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This explained why spruce, with its high resistance factor, was found to be seriously degraded at certain sites.

Results indicate that soil type and pollution were major factors to bacterial degradation. The study shows that a correlation exists between the level of nitrogen/phosphorus existing in the wood and the degree of degradation.

Wooden piles found in permeable soil, such as sand, showed higher instances of severe bacterial attack compared to wooden piles found in non-permeable soils such as clay and peat.

The same, however, could not be said for archaeological wood. In contrast, degradation in archaeological wood occurred slower in sandy soils than it did in peat. The study also found no correlation between bacterial degradation and age.

The structural integrity of wood is important to archaeologists as it allows them to recognise the original sample shape and size.

The study concluded that the impact of bacterial degradation in wood is underestimated in Europe in general and more specifically in the field of archaeology.

Determining the patterns of exposure to pesticides

Essential steps are being taken, in the framework of the Europit project, to determine the patterns of human occupational exposure to immunotoxicants. These patterns are a prerequisite to the assessment of potential risks for workers in agricultural fields, and furthermore to the reduction of health hazards.

Pesticides are widely used in agriculture for preventing or repelling pests, including insects, mammals, plant pathogens, weeds and microbes that destroy crops and property. As a consequence, a great part of the population may be exposed to these compounds.

In spite of this extensive use, knowledge on the health risks associated with prolonged exposure to these compounds is rather poor and major uncertainties still exist. In the case of prolonged, low-dose exposure, in particular, the association between pesticides and the occurrence of adverse effects on human health is often less clear and thus difficult to prove.

The EU-funded project takes essential steps to promote health risk management at the workplace by assessing the immune competence of workers occupationally exposed to organ phosphorous or dithiocarbamates. Assessment starts with the identification of hazards, which must be integrated with information concerning the dose adsorbed by workers, the dose-effect and dose-response for the hazards identified.

In agricultural fields, workers are exposed to pesticides in numerous activities including formulation handling, preparation and application as well as contact with residues on the surface of treated leaves. This difficulty is tackled by defining 'exposure profiles' from all of the activities taken into account and at a local level. These profiles help to determine the contribution of each significant variable affecting the exposure levels.

Once the potential for exposure has been characterised, it can be quantified and compared with an established safe exposure level. For the assessment of the exposure, the urinary excretion of the main metabolite of these compounds, ethylenethiourea (ETU), is determined. The urinary ETU levels determined from a control group of unexposed subjects are set as a reference biological value for the general population at European level.

Through knowledge of the patterns of exposure to pesticides, researchers will be able to consider whether the risk posed to agricultural workers meets the established safety standard of 'reasonable certainty of no harm'.

ENVIRONMENT

Effective model coupling for oil spills

The Cleopatra project offers a better estimation of the driving mechanisms for surface pollutants such as oil slicks thanks to a model coupling system.

The project aimed at developing an advanced alert and tracking system for chemical effluents and oil pollution using an integrated set of data and tools. Special areas of interest are those that are vulnerable to pollution, such as the Mediterranean Sea. By employing modern space technologies as well as recent meteorological and ocean scientific research, the system may support preven-

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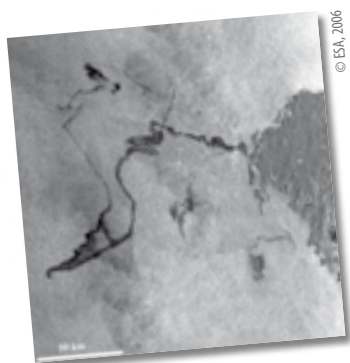
tion, mitigation and assessment of oil or chemical marine pollution.

Normally, variable geographical meteo-ocean conditions cause movement of oil spills that can be better predicted by using gridded meteo-ocean data. Yet, model performance heavily depends on the reliability and quality of such data, particularly under stormy conditions. To answer this need, researchers completed a detailed review of model coupling issues and took into consideration physical studies, algorithmic tools and scientific/operational systems with well-defined model coupling strategies.

This key project result allows coupling the atmosphere, ocean and wave part of model chains at a higher resolution level for improving pollutant drift modelling. Model communication is conducted through a 'standard' forcing chain. For instance, atmosphere forcing

(winds) drives sea waves, while winds, surface heating and salinity fluxes cause ocean dynamics. Winds, waves and ocean currents provide information on pollution spills, while feedback information is derived by studying the influences of waves on atmosphere and ocean, and of ocean on waves.

This coupling would improve the description of the dynamics of the atmosphere-sea surface boundary layer and provide a better assessment of the key constituents of surface pollution, such as oil slicks. Additionally, *in situ* and/or earth observation data can be linked to models as initial conditions to run the models and play a key role in model calibration and validation. This result is expected to significantly contribute to the improvement of the coastal disaster emergency management activities of national or regional authorities and organisations.

Cutting-edge waste disposal, containment and transportation technology

A Maltese technology developer has produced an innovative concept consisting of a sealed waste storage device and a complementary recovery vehicle and waste recovery strategy. Its main objective is to eradicate shortcomings in conventional waste recovery and transportation methods.

The technology is a patented waste receptacle that is available in a range of sizes and volumes. The containers complement a 'bring in site' concept and also facilitate and promote waste segregation schemes. They can be colour- and bar-coded and installed sub-terraneously.

The main feature of the containers is a mechanical device that automatically opens and closes it using a top lift single hook facility. The containers may incorporate an 'add-on' telemetry transmitter system which allows the operator to monitor the volumes of the SmartBins from a central office and to dispatch a recovery vehicle to the collection site only when necessary.

The technology also facilitates the systematic and orderly storage of separated waste. Its design permits the stacking and grouping of several containers, facilitating transport even on long-haul destinations.

The corresponding recovery vehicle is a specially designed carrier with a state-of-the-art crane and digital scale, which provides valuable data about each collection. The opera-

tor simply replaces a full container with a 'clean' container in one simple and efficient process without any spillage or discharge of contents.

The concept pivots around the need for alternative waste-related solutions and complements environment-related EU directives promoting the sustainable management of municipal solid waste and other waste streams.

The aesthetics of the container as well as its functions make it a cleaner and more effective product which will not only contribute to more efficient waste recovery configurations, but will also help to reduce operators' operating costs substantially. The proposed recovery strategy will improve sorting and handling of separated waste on a large scale and also prevents the cross-contamination of waste streams. These attributes qualify the technology as a proactive waste management solution.

Technical specifications:
- capacity: 2 200 litres standard (other capacities optional);
- tare: 268 kg;
- size: 900 x 1 900 x 1 400 mm;
- material: 3 mm gauge rigid mild steel;
- porthole size: 680 x 560 mm (standard porthole — other portholes optional);
- coating: three coats of durable and environmentally friendly paint (epoxy primer and build coat and two coats high-build semigloss aliphatic polyurethane finish).

The company is looking for waste management contractors or providers of waste management technologies who seek innovative solutions to meet environmental and urban requirements.

Talking to smart homes to improve quality of life

Telling your house to turn on the lights or record a TV programme may be the ultimate high-tech luxury, but for elderly and disabled people voice-operated smart homes could dramatically improve quality of life. The Inspire project has successfully tested such a system.

Based on the results of the 30-month IST project Inspire, the partners are confident that they will be able to have a commercial version of their system on the market within two years. It will be geared initially toward people with disabilities and restricted movement but also any home-owner who wants to enjoy the advantages of operating appliances and devices with speech alone.

Within the property the interactive computer system picks up voice commands from wall-mounted microphone arrays, while remote access is provided via voicemail over mobile and fixed-line communications.

'One scenario could be that someone is on their way home and calls the house to turn on the heating for them, once there they can walk in the door and tell it to turn on the lights. If they wanted to watch TV they could use it to close the curtains and dim the lamps', explains Inspire scientific coordinator Anastasios Tsopanoglou at Knowledge in Greece.

The system, which can be programmed to operate in any language, was tested in five pilot trials in Germany and Greece involving around 100 users.

'The greatest difficulty we faced was enhancing the speech recognition technology to an acceptable level, although we managed to ensure it would recognise voice commands successfully in more than 85 % of cases', Tsopanoglou says. 'Users' reactions were generally very positive, on a scale of 1 to 7 most rated it at 5.5.'

Even so, the coordinator admits that most average users said that, although the system would be a nice feature to have in their homes, they did not consider it essential.

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'The market is not really mature enough for this technology yet for general consumers; however, there is vast potential to use it to help the elderly and disabled', Tsopanoglou notes. 'They could benefit enormously from being able to operate appliances with speech.'

The coordinator estimates that fitting a house with the system would cost approximately EUR 10 000, largely due to the need to run hundreds of cables. 'That could be overcome if new houses are built with cabling pre-installed, or by using wireless technologies such as Bluetooth to interconnect devices', Tsopanoglou says.

Promoted by the IST Results service.

http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/
BrowsingType/Features/ID/73661/highlights/smart+homes

Composing next-generation software component systems

Software component and composition technology is considered to be one of the most promising areas of the future of the information society. The Easycomp project developed suitable methods, tools and environments for allowing flexible, powerful and easy composition of components.

Each entity currently found on the web, such as XML data and software, has the potential to become an active component. Active components are expected to replace documents, desktops, browsers, three-tier architectures and complete applications within the next years. For this reason, suitable technology for uniform and easy component composition is required that would increase reuse of components and hence productivity for both end-users and software engineers.

Urged by this, the Easycomp project developed robust composition techniques for active components. Based on aspect separation and composition, these new techniques are expected to allow users to powerfully adapt components using suitable meta-modelling and code generation methods. Additionally, the developed techniques will also offer dynamic composition of active components for adapting systems.

One of the key issues involved was the lack of homogeneity of components in the different development stages, which are construction time, assembly time and runtime. This diversity in the availability of means for composition causes increased complexity of component-based software development. To tackle this, researchers developed a uniform composition and adaptation methodology that integrates three different composition models applicable over all stages of the development lifecycle of a component into one model.

The individual models offer increased capabilities of reuse and exploitation of artefacts that have been constructed in later phases of the component lifecycle. The integrated model provides a common environment for the components development for each of the three models. Taking into consideration existing commercial off-the-shelf components, the meta-component methodology establishes a sound framework for a generic application programming interface (API) to access component models developed by different companies. Thus, users are expected to have more options when combining different model components.

Collaboration sought: further research or development support, licence agreement, private-public partnership — available for consultancy.

Offer ID: 2648

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Building a personalised network of digital devices

Plans to develop protocols and devices that link together all the audio and video gadgets that clutter homes, handbags and briefcases will unleash an incredible array of new, personalised and location-based services.

Imagine your alarm wakes you up an hour early because it knows you're flying abroad, and there's a traffic jam on the way to the airport. Your coffee maker turns on an hour early too, while the alarm clock gives you the latest headlines about your destination.

Your electronic doorkeeper automatically alarms the house as it senses your mobile phone leaving the house, your car provides traffic updates as you travel, suggesting a detour to avoid congestion. Once at the airport, you buy duty free with your mobile phone. When you reach your destination you can buy movies and videos online, which will be sent directly to your home media centre.

These are the types of service that the IST programme-funded ePerSpace project wants to enable, and once that functionality is there, inventive companies will be able to design a host of new, currently impossible, services.

It's an extremely ambitious project, not least because this type of functionality has been promised for years, but technical issues have dogged all attempts to achieve it.

In part this is because few attempts at personalised network services featured all the links in the chain — the telecoms, electronics, software, audiovisual, content and service companies required to develop integrated services. ePerSpace, however, provides a who's who of European technology companies, including some world players like France Telecom, BT, Motorola, Telefónica, Rai and Siemens Mobile.

'We demonstrated our technology for a number of standalone devices in February', said Pierre-Yves Danet, project coordinator of ePerSpace and head of the 'Services for the home' R&D unit at France Telecom, during an interview in November 2005. 'Now we're integrating those devices together for a demonstrator in January. This will show the system working in a cohesive network', he said.

The soul of the system is the user profile, which defines user preferences in news, TV and music. It will contain information about the users' friends and family, and it will be linked to their calendar to keep it up to date on their work and life schedule.

The profile resides on a home gateway, the hardware system that will be the heart of your digital life, pumping binary oxygen to all the elements of your extended network. 'The gateway links with all the individual devices and provides them with information as they need it', said Danet.

This is already a significant advance on what has gone before. Many attempts at personalised networking were too clunky, requiring way too much maintenance and user intervention to be useful. ePerSpace created a system that can be managed from one point. And if the profile or calendar needs to be updated, the user can do it from any networked device, anywhere in the world.

The gateway links to all the other essential services in the chain (the content, service and location management platforms), so your music, videos and news, your banking and gym membership, and your travel and schedule are all handled from one point. The home gateway will host the user profiles of all the family members, so each one gets the content and services they need.

To make the system work, each device requires a piece of software that identifies itself as part of the network and details the format it needs to see and display information.

'This is quite difficult because all devices have different formats and different form factors — a mobile phone has a small screen and uses one type of data, a TV has a huge screen and receives data in a different way', said Danet. Again, the home gateway is designed to deliver information in the most appropriate format, ultimately sidestepping the intractable problems caused when each device tries to translate the data on the fly.

Data is transferred through three primary networking technologies: broadband, WiFi and Bluetooth. All are mature technologies, which manufacturers are already integrating into different products. Still a lot of integration work remains to be done before the personalised network of science fantasy becomes science fact. 'This is a research project. To develop it into a commercial application will require another two to four years of collaborative effort', said Danet.

Security is also still a big issue, as is finding the best business model to deploy personalised types of services. 'Privacy and security are big problems, but we are working with the regulations on privacy and security developed by the EU and national governments', said Danet. For example, in France it is illegal to host biometric information, such as a fingerprint, on a central database like the home gateway.

So ePerSpace uses the mobile SIM card containing that data. If a user wants to open the front door with his or her fingerprint, the home gateway compares the fingerprint to the data on the mobile phone. In the ePerSpace system the gateway could identify friends in the same way, either admitting them to the home or putting them in contact with the user.

Even so, Danet recognises that while all these services provide the ultimate in convenience and comfort, they present a potential worry, too, and part of ePerSpace's plans include solving the security and privacy issue, and addressing user concerns.

The project aims to attack those problems in earnest in a second phase.

Active listening gives meaning to digital music

Imagine a home hi-fi system where music was automatically categorised according to preferences, where you could read the lyrics as you listen, summon up a favourite tune by humming it, and play along with your favourites. It may sound farfetched, but all these functions and more have already been achieved.

The SemanticHIFI project, coordinated by the Paris-based music technology institute, Ircam, and made possible by IST research funding, is unique. It represents a quantum leap in home music technology, in which access to musical content, and the ability to manipulate it, have hardly advanced since the days of the gramophone.

Psychologists report that when we can manipulate a thing, we understand it better. In that case, society's understanding of music should increase exponentially when SemanticHIFI, a new system for manipulating musical content, takes off.

'Essentially, we are adding descriptions to musical content', explained Ircam's Hugues Vinet, the project coordinator, in November 2005. 'This allows for more interaction with music, so users can do more than just passively listen. Actually, it's about making our sophisticated software tools for professional musicians available to a broader public.'

These tools enable a wide variety of functions. Some address ways to browse the large number of recordings that now inhabit the average hard disk. 'Browsing techniques for digital music were very basic', explained Vinet. 'You could only search "editorial" information, such as titles.' But SemanticHIFI will allow people to label and browse their own collections according to actual musical content, categorised as they see fit. 'It's not our object to define genres, but to let people define their own', explained Vinet. 'Then the system learns the definition criteria, and can label other titles accordingly.'

'Browsing by example' is another intriguing possibility — simply select the kind of music you want to hear, on the basis of features such as tempo or orchestration, and the programme comes up with a list of comparable pieces.

Naturally, exploring musical content in this way requires a mode of visualisation. 'So we have developed a system that analyses the temporal structure of a piece of music and develops a graphical map or interface based on that', explained Vinet. 'So if you click on one of the elements in the graphical map, you go directly to that part of the music. What's more, using this algorithm you can generate a musical summary as a new file — condensing a long piece into a much shorter one, but complete with all its variations. Then you can manipulate musical content via the summary and the graphical map.'

Another way of navigating through musical documents involves the ability to separate different instruments, using sound manipulation techniques that reproduce sounds in space. Here, SemanticHIFI challenges the usual recorded music model, which is undoubtedly polyphonic: 'We have to persuade the music industry to evolve its production process by providing multitrack recordings', said Vinet. Being able to separate the instruments allows the listener to arrange an orchestra in space, choosing where to place the violins, for example. It invites listeners and musicians to really understand the construction of a piece, and play along with it. 'The system even includes simplified musical instruments that you can play with, using your voice', Vinet explained.

SemanticHIFI's system architecture has several components: a hi-fi box in the living room will house most of the capabilities. PC applications will enable more advanced functions, such as performance ones. Other capabilities are peer-to-peer file sharing — 'In a non-copyright infringing way', Vinet insisted. 'Users can share metadata — their indexing and manipulations — but not original tracks. The computer identifies the original behind the metadata, and if you don't own it, will suggest you buy it. SemanticHIFI is therefore compatible with the commercial model.'

The project, which ends in November 2006, unites some of the leading institutes in music technology research. Germany's *Fraunhofer Institut*, which developed MP3, is working on peer-to-peer applications and 'query by humming', while Sony Computer Science Lab (Paris) does the inter-document browsing functions, categories, and sophisticated playlist capabilities. Pompeu Fabra University in Barcelona is responsible for the real-time interaction, performance, and voice-controlled interface, and Israel's Ben Gurion University is working on signal analysis, 'browse by lyrics' and the instrument-separating functions. Ircam research teams are involved in audio indexing, sound spatialisation and real-time interaction. Vinet explained that each partner owns the technology it developed, and can license it.

In addition, the project counts Berlin's Native Instruments and the Sony European Technology Centre in Stuttgart as its industrial partners. Sony handles the integration of the technologies into a box, which is the next step. 'We're two thirds of the way there', said Vinet. 'All the technologies have been validated and the first application prototypes will be ready early in 2006, for a first trial at the *Cité des Sciences* in Paris.' He believes it is up to industry to decide the commercial future of the project: 'The box itself may be a product, and parts of it may be adapted into mobiles or games — there are many possibilities', he added.

But whatever form SemanticHIFI takes, one thing is for sure: listening to music will never be the same again.

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IT AND TELECOMMUNICATIONS

Faster and more efficient argumentation-based agent negotiation

The FEEL project has developed new algorithms for negotiation between software agents, based on the notion of argumentation.

These algorithms are advanced techniques, which have involved basic research and construction of laboratory prototypes. They have been tested in simulation and also have been integrated with the FEEL software.

Within the FEEL project, these algorithms were designed to address the particular requirements of managing intrusiveness in the pervasive computing context. In this context, their role is to conduct negotiation in order to regulate information flow.

The algorithms have much wider applicability and will be relevant in a variety of distributed computing situations. This includes other information systems applications involving users interacting with real-time information flows, as well as online negotiation within the e-business context.

These algorithms can be used as the basis for applied research in a variety of contexts and also future basic research. They have been published as academic papers.

Delivering on digital content's full potential

The hardware and software developed by a European project aim to unleash the full potential of digital media by offering the secure creation, delivery and consumption of audiovisual media across a wide range of hybrid networks and platforms.

The IST-funded project Tiramisu focuses on protection of intellectual assets by securing the content with a digital rights management (DRM) solution, while maintaining interoperability and use of open standards.

According to project coordinator Yael Lapid, the project seeks to research, develop, exploit and integrate technologies for providing easy and inexpensive access to protected multimedia content to home users on appliances such as television sets, PDAs, mobile phones and PCs.

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In terms of the advantages that Tiramisu offers over current technologies, Lapid is unequivocal that their solution offers real progress to all interested parties.

'There are two principal uses for Tiramisu — super distribution and roaming. Super distribution applies when the customer is also a distributor', she says. 'This paradigm, usually viewed by the content industry as the biggest threat to their business, has been turned by Tiramisu into a powerful promotion tool. Our approach encourages free distribution of [protected] content, and maintains control over the business by enumerating content consumption rather than content distribution.'

The other major plus is roaming, which Lapid describes as the ability to use licensed content independently of location, device, or network connection. 'The Tiramisu approach entitles a consumer [to] a licence to the conceptual digital item, rather than to a physical copy [...] It means that a user will only need to insert a smartcard in a device and all content that was licensed will be accessible at the adequate quality of service', she says.

'The Tiramisu approach has been communicated through various forums and standardisation bodies and we are in the process of validating all the features of the Tiramisu framework. Everything in the project is on target, which means that in the two months that are left until the end of the project only final tests are left to be done', says Lapid.

In essence, Tiramisu's approach has been to adapt existing DRM technologies and develop new technologies where necessary using existing and emerging open standards. The project has also contributed to the development of new standards in order to provide robust, flexible and affordable protection of new multimedia formats such as object-based and advanced 3D graphics.

With content creators currently waging war on rampant Internet piracy of digital media, Lapid acknowledges that gaining acceptance for a new approach to DRM was always likely to meet some resistance.

'There were several hurdles to overcome. The main difficulties are lack of standards, divergence of efforts toward industry agreement, the paranoia of the content industry and its belated reaction to technology achievements', she says.

While noting that these difficulties are beyond the project's control, Lapid believes that Tiramisu's main message is slowly gaining traction. 'We see various efforts and alliances that have basically adopted the Tiramisu approach and if some of these prevail it will be partly due to the project's impact', she says.

Given the skyrocketing demand for secure delivery of digital media, the commercial potential for Tiramisu's solution is very high, says Lapid.

'There are plans to commercially exploit the project's results, but these are pending until standardisation issues are sorted out. However, since the prominent standardisation activities are basically in line with the Tiramisu approach, exploitation is not expected to face any technical hurdles', she ends.

I robot, your companion

Robotic technology is advancing apace and now a top team of European scientists and engineers hope to make the leap from single function 'dumb' machines to adaptive learning machines.

The concept of a cognitive robotic companion inspires some of the best science fiction but one day may be science fact, following the work of the four-year Cogniron project funded since January 2004 by the IST's FET initiative. But what could a cognitive robot companion do?

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'Well, that's a difficult question. The example that's often used is a robot that's able to fulfil your needs, like passing you a drink or helping in everyday tasks', says Dr Raja Chatila, research director at the Systems Architecture and Analysis Laboratory of the French *Centre National de la Recherche Scientifique* (LAAS-CNRS), and Cogniron project coordinator.

'That might seem a bit trivial, but let me ask you a question: in the 1970s, what was the use of a personal computer?' he asks.

That's a good point. In fact, it was then impossible to imagine how PCs would change the world's economics, politics and society in just 30 years. The eventual uses, once the technology developed, were far from trivial.

Cogniron set out on the same principle, given that society is constantly evolving, and the project partners hope to tackle some of the key issues that need to be resolved for the development of a cognitive robot compan-

ion which could provide assistance to disabled and elderly people or the general population. Who wouldn't like, for instance, their breakfast ready when they awoke, deliveries accepted while they were at work and their apartment cleaned upon their return?

The key issue governing these tasks is intelligence and developing intelligent behaviour on a number of fronts, the corner stone and main work of Cogniron.

Organised around seven key research themes, the project studies multimodal dialogues, detection and understanding of human activity, social behaviour and embodied interaction, skill and task learning, spatial cognition and multimodal situation awareness, as well as intentionality and initiative. Finally, the seventh research theme, systems levels integration and evaluation, focuses on integrating all the other themes into a cohesive, cogitating whole.

Dr Chatila summarises the purpose of the seven themes. 'Research breaks down into four capacities required by a cognitive robot companion: perception and cognition of environment, learning by observation, decision-making, communication and interaction with humans.'

Decision-making is a fundamental capability of a cognitive robot, be it for autonomous deliberation, task execution, or for human-robot collaborative problem solving. It also integrates the three other capacities: interaction, learning and understanding the environment.

'Getting a robot to move around a human, without hurting them, and while making them feel comfortable, is a vital task', says Dr Chatila.

To work, it means a robot must pick up subtle cues. If, for instance, a human leans forward to get up, the robot needs to understand the purpose of that movement. What's more, much of human communication is non-verbal, and such cognitive machines need to pick up on that if they are to be useful, rather than irritating.

Even in verbal communication there are many habits robots need to acquire that are so second nature to humans that we never think of them. 'For example, turn taking in conversation. Humans take turns to [talk], we need to find a way to make robots do the same', says Dr Chatila. A robot which keeps interrupting would get on an owner's nerves.

To tackle the problems, the researchers took inspiration from natural cognition as it occurs in humans, which is one reason why a cognitive robot companion needs to be able to learn.

Take perception. In machines, the environment is usually represented in a geometric model, which is excellent for a quantitative snapshot of an area, like an architect's blueprint. But humans don't perceive their environment that way; they use a topological model, which provides a more qualitative representation of reality. 'An architect's blueprint might tell you the dimensions, but a topological model will tell you the function of elements, like a door, a corridor, or the nature and use of a given room, for example.'

Despite its highly ambitious aims the project made enormous progress and the team feel confident they will meet their criteria for success: three concrete implementations, the so-called 'key experiments' being implemented on real robots for the integration, demonstration and validation of the research results.

One experiment will feature a robot building a model of its environment in the course of a home tour, another will feature a curious and proactive robot that will be able to infer that a human needs something to be done, while the third one will demonstrate a robot's ability to learn by imitation and repetition.

In fact, the project has already partially implemented all three experiments, 18 months before the project ends. 'The three experiments are an expression of our achievement in research and integration', says Dr Chatila.

He emphasises that this is a promising start, but it will be a very long road before a fully functional cognitive robot companion will be realised and potentially commercialised. Cogniron will advance the state of the art and understanding of the different components required but will not yet allow a fully integrated robot endowed with all the required capacities to be built.

New virtual world order

An EU project will enable virtual reality to take another step into the real world with a series of innovations that make the technology cheaper, more flexible and more powerful.

'The origins of virtual reality grew out of psychedelic philosophy and they were looking at simulating alternative worlds, not realistic simulations as we have today', says Marc Cavazza, coordinator of the IST project Alterne and computing scientist at the United Kingdom's University of Teesside. 'This concept had been forgotten and we wanted to return to it while doing some serious scientific work.'

The project team, which includes seven partners from across Europe, developed software that will let a computer-augmented visualisation environment (CAVE) immersive projection screen run on PC clusters, a type of parallel processing that gives massively more computing bang for the buck. This means it will be cheaper to run, because it uses standard PC technology.

But it also means that the system can use standard PC software. Unreal Tournament, a first person shooter video game developed by Epic, is the reference in current gaming technology. It replicates an entire world with predictable physical laws that govern everything from lighting to player movement and ballistics.

Alterne used the game engine from Unreal Tournament, which creates the graphics in the game, and bolted on a series of modules that enable new physical laws.

'The bulk of the contribution of the project is all the software which has been developed on top of the game engine', says Cavazza. 'Our alternative reality software consists of a series of modules: those dealing with causality, those dealing with physical laws and we also have modules which can be used to describe artificial life.'

What's more, the team designed the system so that other modules to enable new effects can be added to the system when they are required. 'It is only limited by the processing power of the cluster and the imagination of the artist or computer scientist', says Cavazza.

Artists will use the system to create alternative realities as a form of expression. Unfortunately, this is a very limited market in Europe. 'There are probably 100 virtual reality artists in Europe', says Cavazza.

But the system will have other applications, both in computer science and graphics.

'Cognitive scientists, for example, are very interested in our work because it will allow them to test new hypotheses on the nature of the perception of causality and higher brain functions', he says.

For example, causality perception, or the perception of cause and effect, is believed to be instant in humans. When something happens we can immediately identify its cause, implying that it is an inherent part of the perception process.

But the perception of causality is a higher brain function, so normally there should be a delay between perception and recognition of causality. The Alterne system will help cognitive scientists to tease out what exactly is happening. 'Before Alterne, they didn't have the tools to explore that', says Cavazza.

There are also important implications for computer science, particularly human-computer interactions, which are all about causality.

In the meantime, the project is undergoing its final evaluation right now. 'Artists are enthusiastic', says Cavazza. Ultimately, the Alterne system will usher in a new virtual world order.

Virtual reality gets real

Creating close to real-life virtual reality experiences has proved to be costly and has had rather poor results. In response, a European research team has explored how exploiting visual and auditory illusions can possibly lead to low-cost virtual reality simulators of the future.

Nowadays virtual reality is used within a wide range of areas such as medicine and the car manufacturing industry. However, due to problems with cost and quality, the technology has not yet reached a wider market.

Instead of trying to simulate the sense of the person's motion by physically moving the person, which often causes motion sickness, the German-Swedish POEMS project used a perceptually oriented approach towards self-motion simulation. Thanks to funding under the FET initiative of the European Commission's IST programme, their work and findings resulted in a simulator prototype, presented at the 8th International Presence Conference held in London 2005.

At the event, a group of 20 participants tested the prototype simulating the market place in Tübingen, Germany. Although seated, with headphones and a screen in front of them, participants got the distinct feeling of moving as the image on the screen in front of them turned around the square.

Basically the simulator exploits a vection illusion of the brain, which makes us believe we are moving when actually we are stationary. The same can be experienced, for instance, when you are stopped at a traffic light in your car and the car next to you edges forward. Your brain interprets this peripheral visual information as though you are moving backwards.

To enhance the illusion and achieve a higher perceptual realism, acoustics was added to the visual impression. Stationary audio sources, like a fountain and church bells, shifted from ear to ear when performing the virtual turn around the square, strengthening the feeling of movement, Dr Pontus Larsson from Chalmers University in Gothenburg, Sweden explains.

'For the acoustics we found that realistic sounds are more effective than synthetic [sounds] and likewise stationary sources, such as church bells, are more effective than moving sources such as the sound of a car', Larsson says.

'One of the findings in testing the simulator was that participants experienced a slight delay in motion. We are now working on reducing this to zero', explains Dr Bernhard Riecke, the POEMS project coordinator for the Max Planck Institute for Biological Cybernetics. 'None of the participants in the

Bringing the past back to life

Getting a glimpse of life as it was originally lived in places such as Pompeii seems no longer impossible. The IST project Lifeplus enables an immersive 3D-reconstruction of ancient Pompeian frescos through the real-time revival of its fauna, flora and population.

'At Pompeii for example, the visitor would not just see the frescos, taverns and villas that have been excavated, but also people going about their daily life', explains Professor Nadia Magnenat-Thalman of the Swiss research group MiraLab and scientific coordinator of Lifeplus.

A prototype augmented-reality (AR) system requires the visitor to wear a head-mounted display with a miniature camera and a backpack computer. The camera captures the view and feeds it to software on the computer where the visitor's viewpoint is combined with animated virtual elements.

'We are, for the first time, able to run this combination of software processes to create walking, talking people with believable clothing, skin and hair in real time', says Professor Magnenat-Thalman.

Unlike virtual reality, which delivers an entirely computer-generated scene to the viewer, the Lifeplus project combines digital and real views. Crucial to the technique is the software that interprets the visitor's view and provides an accurate match between the real and virtual elements.

'Our platform VHD++ features integrated real-time virtual character simulation technologies', says Professor Magnenat-Thalman. According to her, this key innovation allows the plug-and-play of different heterogeneous technologies such as real-time character rendering in AR, real-time camera tracking, facial simulation and speech, body animation with skinning, 3D sound, cloth simulation and behavioural scripting of actions.

'To achieve the requirement of "true mobility", a single mobile workstation is used in our current demonstrations, after improvements in the streaming image capturing and introduction of hyper-threading in the platform code', says Professor Magnenat-Thalman.

'After the project's completion in August 2004, we developed further research on more realistic rendering', she continues. 'In future research we would like to give a better sense of presence by adding automatic behaviour of virtual characters when real people enter the virtual scene. We would like to develop research on interchanging natural consciousness between real and virtual, and between virtual characters.'

According to her, Lifeplus paves the way for a new form of cultural tourism. 'In Pompeii, we asked different people to visit in AR the tavern. They were amazed', she says. 'Although Lifeplus is still in the stage of a testbed, in the future our platform could be distributed for various realities applications, like location-based entertainment, e-visitor attractions as well as on-set visualisations for the TV/movie industry.'

The Lifeplus project exhibited at the 'Future Parc' of CeBIT, the world's largest ICT fair, in Hanover, Germany from 10 to 16 March 2005, where visitors were able to experience the augmented model of a real Pompeian site.

© Lifeplus project, 2006

test, however, reported any motion sickness and even in other tests we have not registered any discomfort.'

Using sensory illusions in virtual reality proved successful in creating a state of presence and motion as well as being cost-effective and efficient, Riecke explains. It competes well with more expensive simulators using motion platforms, which from earlier research have shown not to significantly add to the experience of motion.

Although the simulator built by POEMS is a proof-of-concept only and further research is needed, since it ended in December 2005, the project has engaged in further developments towards what in the end could become a commercial product.

'We are currently trying to get new partners into the boat and are negotiating with people from the Netherlands, Britain and Germany', he says. The aim is to build on the findings from POEMS and develop a prototype that includes physical motion. Riecke envisages that such a low-cost simulator, in the future, would allow wider use in the gaming and entertainment industry as well as architectural markets.

IT AND TELECOMMUNICATIONS

Emotional intelligence for computer-based characters?

A computer character capable of realistic emotional expressions in human-computer communication has been prototyped and may soon be incorporated into working applications.

The research team in the IST project ERMIS, which focused on linguistic and paralinguistic cues in human speech and finished at the end of December 2004, created a prototype able to analyse and respond to user input. The team included researchers with skills ranging from engineering and computer science to psychology and human communication.

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'In looking for emotional cues in language, we worked on three major inputs to the system', explains Stefanos Kollias of the National Technical University of Athens. 'Linguistic analysis of speech in English and Greek, work on paralinguistic features such as intonation and emphasis, and the study of facial expressions.'

In the analysis phase, the team extracted some 400 features of common speech, then selected some two dozen as the most important in expressing emotion. These terms were then fed into a neural network architecture that combined all the different speech, paralinguistic and facial communications features. For facial expression, about 19 were selected as the most relevant and were input accordingly.

The results of this analysis were incorporated into a prototype system with several on-screen characters, each of which were capable of reacting to and reproducing the emotional content in speech and facial expressions. By interacting with their human subjects, these computer characters would attempt to make the user angry, happy, sad or even bored. Sometimes with great success, says Kollias.

He emphasises, however, that the team did not just focus on extreme emotions. 'We tried to develop real-life situations, with the language and facial reactions that expressed everyday emotions over a wide range. For example feeling positive and eager to participate, or negative and less motivated.'

The result of the ERMIS team's work is what they call the 'sensitive artificial listener', a computer character that is capable of much more realistic expression of emotions in human communication. The project partners have taken these results and are now analysing them with a view to incorporation into their own products. BT for example is very interested in how the results could be used within its call centre technologies. Nokia, another partner, is investigating the possibility of incorporating such abilities into its multimedia mobile phones. Partner Eyetronics is incorporating what has been learnt into its own 3D virtual models, in order to enhance modelling of facial movements in virtual characters.

'Our work has shown that combined AV [audiovisual] and speech analysis is both feasible and has the potential for incorporation into working applications', says Kollias. The project results have also lead to a follow-on initiative, he says, the four-year FP6 project Humain. Kollias emphasises, however, that it is too soon to judge the full extent of interest in the project results, as they are still being presented at conferences around the world.

Information service for elderly and disabled persons

Aiming at promoting the utilisation of advanced digital TV technologies, the SAID project emphasised remote interactive service development.

A personal information service has been developed that can provide information search and automatic response according to user's needs. The emerging interactive services through digital TV are expected to become a key technological market within the next years. Taking advantage of these technologies, the SAID project focused on offering advanced services for the potentially socially excluded groups, such as disabled and elderly persons. The project's major objective was not only to provide social services but also to make IST accessible to all through provision of basic care services.

Addressing the end-users needs, SAID developed information interactive services that are accessible to both elderly and disabled users through regular TV. More specifically, researchers realised suitable intelligent agents technology required to refine filtered lists of topics personalised according to user profiles. Based on an aided search engine, the interactive information service employs a search-tree approach that includes topics and sub-topics with dynamic change of content.

Unlike the interactive information service that is based on user requests, the active information service doesn't require the user's explicit request. This service is also based on intelligent agents that monitor the most interesting topics to the user and provide suggestions through pop-up messages on the TV screen. The suggestions derive from the elaboration of user profiles and special attention was paid to the user-friendliness, relevance and timeliness of delivered information.

The SAID project developed a set of innovative added value services that could find useful application in iTV-based technology. Further collaboration is sought with distributors, venture capital investors and communications carriers.

Chatting freely with animated historical characters

Once upon a time, there lived the great Danish storyteller, Hans Christian Andersen. Today, aided by computers, a virtual Andersen is entertaining youngsters in his home town of Odense. His natural and interactive communication talent has aroused the interest of the education and gaming industries.

Walk into the Hans Christian Andersen museum and you might see and hear the man himself. Though only virtual, he can hold visitors' attention for up to 15 minutes, chatting with them about himself and telling his fairy tales.

He is the fruit of NICE, an IST project which has developed software enabling dialogue with animated characters. The project partners created two animated characters for museums in Odense and Stockholm. Visitors can have speech and gesture conversations with the legendary fairy tale author or play spoken computer games with a character called Cloddy Hans.

According to project coordinator Niels Ole Bernsen, most speech systems are task-oriented. 'They typically read out e-mails or train timetables. Our project built a more responsive system, we call it domain-oriented, mimicking the way humans talk and interact.'

Thanks to some 600 output templates and primitives, the NICE system recreates the original author's personality. It also enables Andersen to chat with others about his life and stories, or to respond correctly to both verbal and non-verbal input. For example, he can make gestures or facial expressions in line with visitors' remarks or questions, whether in English or Swedish.

The Andersen character was designed for an entertaining museum setting, where input and output errors made by the character and visitors are not important and where users will spend no more than 15 minutes conversing with him. A typical PC game will contain up to 30 hours of carefully programmed content.

Nevertheless, according to Bernsen, the system's ability to link spoken conversation with 2D input gestures in a 3D dynamic graphics virtual world is sure to interest the education and gaming industries. 'To move ahead with commercialisation, we will demonstrate our system to interested parties. We will also measure how long it takes to port the system to other historic animated characters, such as scientist Sir Isaac Newton. If we can do this work quickly, we may even complete it after the project officially ends.'

Computer games companies have expressed interest in the system's abilities to recognise natural language and to manage an entire conversation through words or gestures. 'Language understanding underpins our system', says Bernsen. 'Andersen can understand whether people's remarks are insulting, irrelevant or comprehensible, then respond appropriately. All dialogue systems need a management module like this.'

Games companies who have seen the project's animated characters are also impressed by the fact the system actually works', says Morgan Fredriksson, of project partner Liquid Media. 'NICE developed a system that offers users genuine interaction with characters', he adds. 'It also generates far richer responses from the character than comparable PC games can do, because you can ask the character questions outside of its knowledge domain.'

Freeman notes that the next generation of PCs and games consoles will offer huge graphics and content. But to make the most of these features without hiring many more developers, games companies will increasingly need to generate content and characters in a smart fashion. A task perfectly suited for natural and interactive communication systems such as NICE's.

Also of note are NICE's speech recognisers, based on acoustic data collected from English- and Swedish-speaking children from 30 nations. This acoustic data was made available on the project website and may be sold or traded commercially.

The recognisers can recognise a child's speech with reasonable accuracy, a feature lacking in traditional speech systems. 'We discovered children like to tell Andersen about their lives and consumer goods such as mobile phones. The real Andersen loved technology, so we programmed our character to respond to what they tell him', says Bernsen.

The partners have also endowed their character with more knowledge than is contained in the system. 'If the kids ask the writer what he knows about cars, for instance, a special module searches the Internet for information on the subject', says Bernsen. 'He will then reply using some of that information. By integrating even more information, whatever Andersen learns from people he talks to, we could create almost seamless conversations.' This feature has great potential for the education and entertainment sectors, notes the coordinator.

Other goals for the partners are to see if their platform could be adapted for other languages or historic figures. They also hope to create a web-integrated Andersen who can learn from visitors and 'see' them. This would result in a highly immersive system, in which people would feel they could truly interact with characters from the past.

Promoted by the IST Results service.

http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/BrowsingType/Features/ID/74053/highlights/chatting

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Input data for winning the game

Based on ultrasound technology, a new wireless measurement system offers accurate measurements of speeds, accelerations and distances of players participating in any sport event.

By transmitting sequences of ultrasound pulses from various stable points in a playing area, the newly developed system can provide measurements for a complete group of sportsmen. Aided by the acoustic propagation speed, the required time for signal to travel between the stable points and the athletes can provide the distances covered between each athlete and the receptor.

The receptor system uses trigonometric calculations for deriving spatial locations, which is useful feedback for analysing the sport event. Compared to most GPS systems currently in use, this innovative system is cheaper and more accurate. Most importantly, it can allow detection in both closed and open-air sport field areas during the sport activity at regular intervals and it is wireless.

The wireless system does not rely on the time-consuming and complicated filming or digitalisation of photograms. Moreover, the measurement system offers immediate results that can be further analysed in terms of consequences from each player performance. This constitutes valuable data for drawing up techniques and tactics to win sport competition activities.

Industrial partners interested in integrating this technology into their process or the adaptation and optimisation of formulations for customised applications are sought. The innovative technology is offered for licence agreement or technical co-operation making it suitable for a new application or sector as well as meeting new or current market needs.

Promoted through the IRC network.

Collaboration sought: licence agreement, information exchange/training, other.

Offer ID: 2593

Multimedia goes multichannel

At the crossroads of broadcasting and Internet media services lies the IST project Savant, which offers broadcasters and users multimedia content delivery to a wide range of devices any time and anywhere.

Savant aims to make digital television and the multimedia home platform (MHP) more popular, and create more uses for digital TV by offering synchronous transmission of multimedia content over broadcast and broadband channels, explained Takebumi Itagaki of Brunel University and Savant project coordinator, during an interview in December 2004.

'For example,' continued Itagaki, 'some of our partners are public broadcasters which are required by law to deliver certain minority items such as sign language etc. to viewers who represent less than 5 % of the real audience.' But this consumes part of the broadcast spectrum. So Savant thought IP and synchronised access set-top box (STB) delivery would be a viable alternative.

This led Savant to develop a technical platform that allows TV providers to offer enhanced scalable digital services. 'Some of the items could be sent over the Internet but for some items like video and compressed audio this can be difficult to do', said Itagaki. This calls for broadcast transmission of TV content at the same time as multimedia content over the Internet, and combining them at the STB. Scalable here means that the content at the STB can be resent to other devices such as a Tablet PC or PDA.

To illustrate how a user could benefit, a current affairs demonstration was developed drawing on content from project partner RBB, a regional German broadcaster. This personalised digital TV service offers the immediacy of traditional TV, the portability of a newspaper and the interactivity of the Internet while being tailored to users' personal interests. To avail of this, users must have a DVB-MHP STB where the broadcaster's service is installed. Following service activation, the STB automatically records and stores all programmes that correspond to the users' preferences for 24 hours.

'A news story in our context is […] enriched with additional background information, audio information or web pages with textual information', added Wolfgang Putz, project partner from the Fraunhofer Institute for Integrated Publication and Information Systems. Sign language and subtitles can also be saved in the archive.

Savant's software enables users to easily access the vast array of archived material and additional information any time. Enabling this is the metadata-tagging by broadcasters to provide enriched content, which includes the title, a brief description, content classifiers, as well as related programme information such as duration, format, time of broadcast and any additional content such as audio files, web pages etc. In addition, broadcasters describe device-specific metadata elements that allow the translation of content to appropriate formats for the target device.

Thanks to the classification of the material, users have a number of options. 'It means that you have an archive of all the news stories of the day, with different access possibilities for the end-user and the user can say "I'm only interested in this and that story. Make me a small programme out of this set of stories"', explained Putz.

The categorisation also allows users to browse the content, select content based on their own criteria, and then generate personalised playlists.

Beyond TV, the same services can be supplied to PDAs, PC or Tablet PCs at home or elsewhere. In addition to acting as a TV receiver and storage device, the Savant STB can act as a server to distribute content to any Internet-enabled device which can then use the STB-installed services from almost anywhere.

Unfortunately for Savant, as Itagaki explained, currently most STBs, in the case of the United Kingdom, are without MHP, which makes it difficult to make those extra services and extra interactions. 'This technology is here, it just needs to be implemented', he added in conclusion.

Promoted by the IST Results service.

http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/BrowsingType/Features/ID/73208/highlights/savant

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BabyBot takes first steps

BabyBot, a robot modelled on the torso of a two-year-old child, is helping researchers take the first, tottering steps towards understanding human perception, and could lead to the development of machines that can perceive and interact with their environment.

The researchers used BabyBot to test a model of the human sense of 'presence', a combination of senses such as sight, hearing and touch. The work could have enormous applications in robotics, artificial intelligence (AI) and machine perception. The research is being funded under the FET initiative of the European Commission's IST programme, as part of the ADAPT project.

'Our sense of presence is essentially our consciousness', says Giorgio Metta, assistant professor at the Laboratory for Integrated Advanced Robotics at Italy's Genoa University and ADAPT project coordinator.

Imagine a glorious day lying on a beach, drinking a piña colada, or any powerful, pleasurable memory. A series of specific sensory inputs are essential to the memory.

In the human mind all these sensations combine powerfully to create the total experience. It profoundly influences our future expectations, and each time we go to a beach we add to the store of contexts, situations and conditions. It is the combination of all these inputs and their cumulative power that the ADAPT researchers sought to explore.

'We took an engineering approach to the problem; it was really consciousness for engineers', says Metta. 'Which means we first developed a model and then we sought to test this model by, in this case, developing a robot to conform to it.'

Modelling, or defining, consciousness remains one of the intractable problems of both science and philosophy. 'The problem is duality, where does the brain end and the mind begin, the question is whether we need to consider them as two different aspects of reality', says Metta.

Neuroscientists would tend to develop theories that fit the observed phenomena, but engineers take a practical approach. Their objective is to make it work.

Called the synthetic methodology, it is essentially a method of understanding by building. There are three steps: model aspects of a biological system, abstract general principles of intelligent behaviour from the model, apply these principles to the design of intelligent robots. Model, test, refine. And then repeat.

To that end, ADAPT first studied how the perception of self in the environment emerges during the early stages of human development. So developmental psychologists tested 6-to-18-month-old infants. 'We could control a lot of the parameters to see how young children perceive and interact with the world around them. What they do when interacting with their mothers or strangers, what they see, the objects they interact with, for example', says Metta.

From this work they developed a 'process' model of consciousness. This assumes that objects in the environment are not real physical objects as such; rather they are part of a process of perception.

The practical upshot is that, while other models describe consciousness as perception, cognition then action, the ADAPT model sees it as action, cognition then perception. And it's how babies act, too.

When a baby sees an object that is not the final perception of it. A young child will then try to reach the object. If the child fails, the object is too far away. This teaches the child perspective.

If the child does reach the object, he or she will try to grasp it, or taste it or shake it. These actions all teach the child about the object and govern its perception of it. It is a cumulative process rather than a single act.

Our expectations also have enormous influence on our perception. For example, if you believe an empty pot is full, you will lift the pot very quickly. Your muscles unconsciously prepare for the expected resistance, and put more force than is required into lifting; everyday proof that our expectations govern our relationship with the environment.

Or at least that's the model. 'It's not validated. It's a starting point to understand the problem', says Metta.

The team used Baby-Bot to test it, providing a minimal set of instructions, just enough for BabyBot to act on the environment. For the senses, the team used sound, vision and touch, and focused on simple objects within the environment.

There were two experiments, one where BabyBot could touch an object and a second one where it could grasp the object. This is more difficult than it sounds.

If you look at a scene, you unconsciously segment the scene into separate elements. This is a highly developed skill, but by simply interacting with the environment the BabyBot did its engineering parents proud when it demonstrated that it could learn to successfully separate objects from the background.

Once the visual scene was segmented, the robot could start learning about specific properties of objects useful, for instance, to grasp them. Grasping opens a wider world to the robot and to young infants too.

The work was successful, but it was a very early proof-of-principle for their approach. The sense of presence, or consciousness, is a huge problem and ADAPT did not seek to solve it in one project. They made a very promising start and many of the partners will take part in a new IST project, called Robotcub.

In Robotcub the engineers will refine their robot so that it can see, hear and touch its environment. Eventually it will be able to crawl, too.

'Ultimately, this work will have a huge range of applications, from virtual reality, robotics and AI, to psychology and the development of robots as tools for neuroscientific research', concludes Metta.
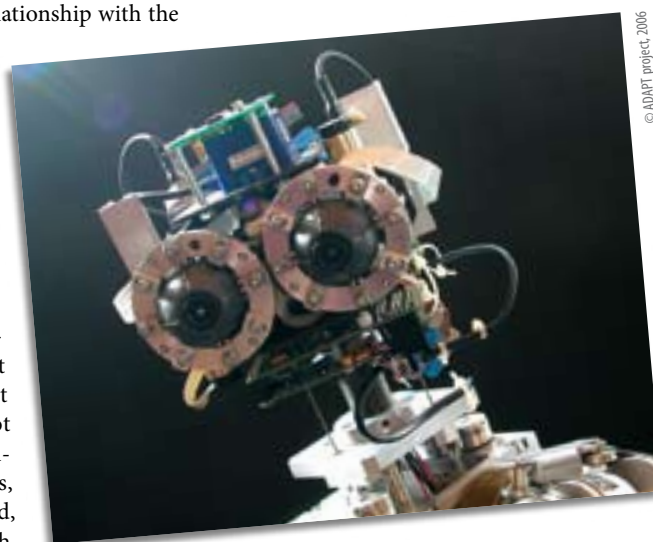
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Electronic butlers to facilitate human-to-human interaction

Need information, a translation, a conference recording? Let the butler handle it. The FAME butler, however, is no ordinary Jeeves; it is an intelligent agent integrating several key technologies that bridges linguistic, cultural, communication and information barriers.

Developed under the IST programme, the FAME information butler breaks new ground in the application of pervasive technologies, creating a system that works alongside users without the need for conscious human-machine interaction.

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Demonstrated in the form of an augmented table and wall display, the butler listens in on users' conversations, picks up on keywords and presents them with pertinent information related to the topic being dis-

cussed. An intelligent virtual cameraman can record what is going on, while speech recognition and real-time translation allow users to interact in potentially any language and conversations to be automatically transcribed for future reference.

'The system is aimed at any group of people who collaborate on common tasks and may have different cultural backgrounds and speak different languages', explains FAME coordinator Florian Metze at the University of Karlsruhe in Germany. 'The information butler facilitates human to human interaction, eliminating the need for people to interact directly with a computer to obtain information and allowing them to work without necessarily being conscious that a machine is working alongside them.'

The FAME butler tracks the topic being discussed through picking up on keywords recorded from an omnidirectional microphone in the centre of the meeting room and processed via a powerful distant speech

recognition system. The keywords are used to link to relevant information in the system database or data uploaded from the Internet, which is then presented to users.

For the demonstrator, a wall display and touch-screen augmented table displaying tokens related to different information and topics under discussion was employed. In addition, cameras set up around the meeting room or conference hall can record the presentations or speeches of different participants, switching cameras and angles intelligently depending on what is going on. A parallel translation system using the same speech recognition technology was also developed and demonstrated between Catalan, English and Spanish.

The system was showcased at IST 2004 in the Hague and at the Barcelona cultural forum in 2004. 'Overall we received a very enthusiastic response, people particularly liked the interfaces and the way the system facilitates multilingual and multicultural collaboration', Metze says.

Several of the partners are continuing to develop the technology in the follow-on IST project CHIL amid plans to commercialise components of the system over the coming years.

In touch with the latest virtual surroundings

A new generation of high-fidelity haptic display technologies promises to lend added reality to virtual environments, as a series of demonstrators have revealed.

'The applicability of haptic [touch and movement-related sensory information] display devices is still very limited, due to the lack of feasible technological solutions, as well as to our very limited understanding of the basic psychophysiology of the sense of touch', says Angelika Peer, from the team of scientific coordinator Martin Buss, at the Munich University of Technology (TUM).

The IST-funded Touch-Hapsys project is focusing on fundamental psychophysical research of haptic perception and feedback, haptic illusions to overcome technological limitations, and is exploring new technologies to significantly improve haptic displays.

'We aim to create the technological basis for engineers to conceive and build better systems for direct interaction with humans

through touch, thus overcoming apparent limitations of existing devices', she says.

According to Peer during an interview in April 2005, mechanical mimicry in artificial devices alone does not provide fully satisfactory solutions for high-fidelity feedback, due to the inherent complexity of the devices needed and the tough physiological and technological constraints. 'We therefore investigated "perceptual tricks" related to the sense of touch to make haptic displays more efficient.'

New ways of generating the most realistic sensation from applying a force, called force feedback, have been explored. 'Special emphasis has been laid on the most challenging problem of hands-free interaction with virtual objects. A candidate technology using magnetorheological fluids in a

controlled 3D volume with magnetic field profiling will be more closely investigated', explains Peer on behalf of project partner Antonio Bicchi of University of Pisa in Italy, as they aim to build their first prototype.

Four demonstrators have been developed, addressing four areas for haptic feedback: haptic interaction with biological tissues, haptic texture rendering and recognition, the simulation of rigid objects with clearly defined sharp edges and multi-modal volumetric exploration systems.

'We work with a large variety of robotic set-ups, virtual environments and tele-operation set-ups. A hyper-redundant haptic interface with 10 actuated degrees of freedom allows us to interact with a virtual environment', explains Peer.

Another demonstrator from ETH Zurich shows how radiologists can feel and see a virtual intestine, and locate tumours and lesions.

Wirelessly reconfiguring hardware to optimise multimedia content

With the rollout of broadband wireless technologies, more and more people are turning to their mobile phones to play games, listen to music and watch movies and TV. Improving the speed and quality of such services is Enamorado.

Over the course of 30 months, this IST programme-funded project developed and tested an architecture covering the whole chain of multimedia content production, processing, transmission and final consumption at end-user terminals, creating in effect a full multimedia content delivery system. The core focus of the work, however, was on improving the quality of services for end-users through the use of an innovative technique employing remote downloads to reconfigure the hardware as well as the software of mobile devices.

'We advanced the state of the art in remote partial hardware reconfigurability', says Enamorado scientific coordinator Luis del Pino at Memondo Graphics in Spain.

In much the same way that software can be updated and modified through downloaded codecs and plug-ins, hardware can be configured to optimise performance depending on what type of multimedia content is being displayed. A field-programmable gate array (FPGA), a type of logic chip that can be programmed and reprogrammed, serves the purpose well, being able to reconfigure itself in real time based on hardware codecs, which, in the context of the project, it receives from an interactive multimedia server (IMS) when users access different types of content.

'Reconfigurable hardware is becoming cheaper and more powerful and will soon start to be used in many applications. As soon as it is employed in mobile phones, hardware codec downloads will be needed', del Pino explains. 'The reason it is becoming popular is that hardware coding and decoding is between 10 and 100 times faster than software coding and decoding.'

That increase in speed can be used in different ways to improve quality, either by increasing the images per second of 3D games or raising the screen resolution to watch TV.

Hardware plug-ins can be received via either push or pull scenarios from the IMS depending on what data the user is obtaining from the content production environment. A simulation server monitors the network and regulates downloads depending on traffic to increase network performance, while tight security and protection mechanisms have been applied to prevent a hardware virus or attack from affecting the chip.

Having validated the functionality of the system in a pilot trial, the project partners are now moving toward commercialising products based on the project results, with del Pino expecting to see downloads for hardware reconfigurability being used 'within two to four years'.

Testing a real object through virtual mimicry has been also applied within the automotive industry, where time to market is an important factor. 'We can test virtually whether technical requirements are met, for example simulating the installation of the car engine and the gears to see whether they have enough space to rotate', she says. 'Tests in the virtual environment are less expensive, thus haptic technology helps save costs.'

Touch-Hapsys demonstrators can also interact with the real environment. 'They can measure the force of an object, which is then sent via the Internet so that the person can "feel" it.' Personnel from the fire brigade at a BASF plant have successfully tested the system for defusing mines.

The system could also be used to check luggage at airports. 'So far X-ray equipment can only visually screen the contents, which often proved not to be sufficient enough, so suspected luggage had to be blown up.'

Currently robotic systems without haptic feedback are in use at the airport in Munich. However, according to Peer, haptic feedback would not only help to make screening more accurate and secure, it would also make the machine much easier to handle. 'Learning time has been reduced from a couple

of months to two or three hours', she adds. 'The machine could be also interesting for the deactivation of mines.'

Following on from the research stage, 'The next step will be the evaluation by psychophysicians. They are going to test, for example, how far the force feedback can be refined and ameliorated, so the application becomes more user-friendly.'

Interest has already been shown by the industry, particularly by the automotive sector. However, 'as this research project is still in the early stages and will result in a follow-up project using an enhanced but similar technology, this is still confidential', concludes Peer.

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It makes sense to communicate with computers

The art of communication becomes a science when dealing with computers. Laying the foundations for future research in human-computer interactions, PF-Star's speech and gesture databases and virtual agents open up new approaches to machine-based communications.

Completed in September 2004, the IST project PF-Star aimed to lay the foundations for future research efforts in multilingual and multisensorial communication (MMC). Over the project's two-year term, researchers worked to develop a range of advanced technological baselines, comparative speech and non-verbal communication evaluations, as well as an assessment of the prospects in some key areas of technology.

Project coordinator Fabio Pianesi of the *Istituto Trentino di Cultura* in Italy explains MMC as follows. 'It's the kind of technology that you need if you want to communicate with the same facility to both the PC and other human beings. The PC needs to be capable of interpreting and reproducing your gestures and facial expressions, as well as the emotion expressed in your speech, in the same way as humans do.'

Interpreting such subtle visual and aural cues, as well as the meaning of the spoken word, is a highly complex business. Facial expression, gesture, and even variations in pitch and tone of the voice all play their part in the way human beings interact. We use and respond to such subtle elements of human communication in our day-to-day lives almost without being aware of it, since our training in such communication develops from birth.

The challenge for the researchers is how to get a machine to interpret and reproduce such communication subtleties. Linguists have for many years reckoned the task to be near impossible given the number of chan-

nels and the complexity of signals involved. However PF-Star's work has provided a promising foundation on which future research can develop.

The project partners in PF-Star have built on several years of research within a variety of national and international projects, most notably Nespole!, C-Star, Verbmobil and SmartKom. In PF-Star, work focused on three key technological areas: speech-to-speech translation, the detection and expression of emotional states in both verbal and non-verbal channels, and core speech technologies for children. The partners also worked in five languages: Spanish, German, English, Italian and Swedish.

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Two project partners, the Royal Institute of Technology (KTH) in Stockholm and the *Istituto Trentino di Cultura*, hired professional actors at the start of the project to study how speech tone and facial expressions changed while expressing emotions. This data was then fed into the project databases, which led to the development of a series of on-screen facial images, or 'talking heads', that offered a machine-based visual alternative to the human face.

These on-screen talking heads, which could be either 2D or 3D facial images, are designed to act as 'virtual agents' that can interact intelligently with human beings, other agents or, depending on their level of autonomy, the environment around them. Such virtual agents are believed to have a huge potential for future man/machine communication, in applications from teaching through helpdesks to entertainment.

The project has also allowed for variations in facial expression resulting from cultural differences, says Pianesi. 'We should not forget that the expression of emotion is culturally dependent. We had to adapt the expressions

on the talking heads to the language concerned, to see how our hypotheses work in the different countries.'

Speech technologies for children were a key area of research for the participants. Error rates for machine-based translation of children's speech are believed to be some 100 % greater than for adults. To help improve such recognition rates, the partners used on-screen virtual agents based on children's faces rather than on those of adults.

PF-Star has laid strong foundations for further research into MMC, says Pianesi. 'Two years ago there were no real databases available covering children's speech, for example. Now we have such speech databases, as well as visual and gesture databases, that we are making available to partners and others.'

The project has also produced several new approaches to machine-based communication. The virtual agents for example are capable of reproducing the emotions expressed, either verbally or as facial expressions, along with the semantics of the message. They can be set to use either both channels (i.e. verbal and non-verbal), or only one.

And the results are more than just data, stresses Pianesi. Since August 2004 the project has made available the databases, the platform and the software for constructing virtual agents, as well as the code to enable further development to be carried out.

While PF-Star is now complete, the project partners are maintaining their development work in the basic technology of machine-based translation. As well as further improving the virtual agents, they are continuing to distribute the technology to client organisations to gain vital feedback on its use. Within FP6, some of the partners have also commenced a project called TC-Star, a six-year project focused on exploring and evaluating new approaches to machine-based translation, and for creating the infrastructure needed for accelerating the rate of progress in the field.

The area of children's speech remains of particular interest, says Pianesi. 'How can we develop interfaces for instruction, for entertainment and so on, that are suitable for children? How can we produce suitable outputs for children?' Certain partners have come together within another FP6 project, CHIL, to further research on children's communication in schools.

Universal codec to set sound free

A unique piece of software that will code any piece of recorded music, or speech, for any device, has been created by a team of European researchers.

The IST project, called ARDOR, developed a unique compressor-decompressor (codec). Codecs are the engine under the hood of software media players.

'At the moment there are dozens of standardised sound codecs. Basically each application has its own dedicated codec and these codecs are optimised for specific input signals, such as speech or music, and specific constraints like bit rate', says Nicolle van Schijndel, ARDOR project coordinator and senior scientist at Philips Research Laboratories.

All the standardised codecs work on different devices and software, but it means a tune that plays on your mobile phone won't play on your stereo.

This codec confusion emerged as software companies developed code that optimised music for particular devices: on a GSM or GPRS phone you need to make the file small, so it can be downloaded quickly, but on a CD you can use huge files for each song.

The size of the file is determined by the bit-rate of the song, essentially the amount of data that defines all the notes in the song. The more data, the better the quality, but a CD-quality song might take a couple of hours to download to a phone.

This is a problem. 'Currently, there are two trends. Convergence of consumer electronics and mobile communications, and the emergence of ubiquitous, heterogeneous network environments', says van Schijndel. Networks formed from diverse and disparate devices, like mobile phones, PDAs and computers for example, cannot easily exchange media files and so lose a lot of their functionality.

That may change. ARDOR developed a generic codec that will, if adopted, enable it to code any piece of recorded music or speech for any device. The bit-rate, or file size of each piece of music, is adapted for each receiving device. It can work for everything from mobile phones to broadcasting.

The project was a success, generated a large number of publications and received intense interest from experts in the field. But more work needs to be done.

'The generic sound coding technology is not yet mature enough to contribute to standardisation, but parts of it may very well be included in future standards. We are closely following standardisation activities, such as MPEG-4', says van Schijndel.

Another problem faced by the researchers is actually getting hardware and software companies to adopt their technology. Industry players often use their proprietary codecs as a competitive advantage by creating a captive audience.

'They will probably only do this if there is a clear need, for example, because their codecs do not deliver the required functionality such as interoperability. I expect this will be the case, but only future can tell', says van Schijndel.

History is on her side. In the past companies found that consumer resistance to captivity forced companies to either abandon proprietary standards or share their technology with others. One day music too will be set free.

Web design for all

New recommendations on accessible web design for persons with physical impairments were developed under the auspices of the IRIS project and could enhance current standards and guidelines.

The IRIS project focused on incorporating requirements of people with special needs or impairments to Internet-based systems and services. More specifically, the project aimed at including adaptability and multimodality functionalities in ready-to-use tools for the IT industry. These functionalities would allow all citizens, including those with special needs or impairments, to participate in the new age IT technologies.

One of the IRIS objectives was to implement a design aid that would lead to a work environment incorporating 'design for all' tools and methods. Such an environment was then used for redesigning and enhancing Internet services for e-working, e-learning and e-commerce application areas. An important aspect of project work involved specification of guidelines and recommendations related to hypermedia, enrolment and accessibility.

The ever-increasing ICT developments have brought significant improvements in the quality of life by introducing on-line education systems, tele-working systems, tele-medicine services, e-commerce activities and many more. By focusing on bringing e-accessibility to all mainstream web-based application areas, the IRIS project gained a better insight on these issues of portals and e-commerce applications. This will allow further optimisation of current standardisation and recommendation practices for a wider information society.

On track with the latest iTV moves

Demonstrating how truly interactive television can be, GMF4iTV's system allows producers to link rich media content to moving objects in normal TV programmes, changing telespectators from passive to active viewers.

'The [GMF4iTV] project is dealing with the complete broadcast chain, from the content side to the end-user side', explained the coordinator Gerhard Stoll of Germany's *Institut für Rundfunktechnik*, a project partner, in January 2005.

'The entire system is based on existing standards', he said. These include the multimedia home platform (MHP) and MPEG standards. 'There is nothing proprietary'.

Taking a plain MPEG-2 video, the content provider decides to associate some additional information to a predetermined object for interaction. Such information can comprise MPEG-4 audiovisual clips, MHP applications, images or HTML. Once selected, the object can be tracked in a semi-automatic way throughout the programme. 'Tracking can work either forward or back', added Stoll, 'so the provider can even start in the middle of a scene'.

From the tracking and annotation, an MPEG-7 metadata description is generated that contains information about the tracked

objects, their movements and the association with additional content.

According to Stoll, for a broadcaster to produce such interactive content, the speed of the tracking depends on the speed of the computer, so it can take 20 to 30 times the real time to play. It also depends on the size and number of objects, and the time taken to associate the pre-prepared additional content. But, as he pointed out, 'familiarity with the system can also improve production speeds.'

Together with the associated rich media content, the dynamic MPEG-7 metadata is then transmitted synchronously to the video sequence, and received by a MHP set-top box (STB).

The STB provides the viewer with the functionality of a new and easy to use graphical user interface to enjoy the interactive content of the object that appears surrounded by a coloured rectangle. Viewers can either access the highlighted content by pressing the appropriate button on their TV remote control or, thanks to a wireless connection between the PDA and STB, by touching the highlighted object on the PDA screen. The viewer can decide on which device to view the additional content. Either on TV, on the PDA or on both. Even watching different additional content on multiple PDAs is possible. This multi-viewer functionality solves today's problem of interactive TV, the lack of support for interactivity for more than one viewer.

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The IST project GMF4iTV's system also supports personalisation. The producer can decide what objects appear in which shots and what type of additional content to display. If this matches the user profile stored on the STB, the interactivity appears. This personalises the interaction. For example, watching a nature documentary, a child might be presented with a simple quiz while an adult watching the same programme would receive additional detailed information about the animal's behaviour.

Alternatively, watching a fashion show, male models could be highlighted for male viewers while women could select female models. Viewers could also be asked at the start of the programme whether they prefer shopping options or designer information, and the choice would be stored in the user's STB profile. Although the three demonstrations, produced by GMF4iTV, relate to sports, music and fashion, it could be applied to any content. From documentaries to educational programmes to shopping opportunities, for example. 'It depends on the interests of the content provider who has to think how to use this new way of direct interactivity with certain objects and what can be added, and how to derive revenue from viewers', Stoll says.

Presented at Amsterdam's IBC 2004 and Munich's Medientage 2004 conferences, the GMF4iTV's demonstrations generated a lot of interest among attendees, says Stoll.

'You cannot use it [the system] in real time because of the authoring process', noted Stoll. 'It is not possible at the moment. Perhaps later, with faster computers and better object tracking', he added.

Adding a new dimension to television

A new advanced 3D-TV system that puts the viewer right in the centre of the movie challenges the broadcast environment by optimising every part of the video chain.

'At Attest, we believe that 3D-TV is that next step in visual quality. However, it can only be brought successfully to the market if all parts of the video chain (content generation, coding, transmission and display) are optimised to one another and are available simultaneously', says Marc Op de Beeck from Philips Research in the Netherlands and coordinator of this IST programme-funded project.

According to him, the introduction of 3D-TV first requires the availability of 3D video content. Within Attest, this need has been satisfied in two different ways. A range camera has been converted into a broadcast 3D camera, which required a redesign of the camera optics and electronics to deliver a full resolution 3D camera, higher depth and pixel resolution. 'Secondly, as the need for 3D content can only partially be satisfied by newly

recorded material, we developed algorithms to convert existing 2D video material into 3D. Both offline (content provider) and online (STB) conversion tools are now available.

'In the introduction period, 2D and 3D-TV will co-exist, thus it has to be compatible with the 2D-TV available today.' Although not yet on the market, Op de Beeck says the introduction of 3D-TV is foreseen in the coming years.

Attest, therefore, developed coding schemes within the current MPEG-2 broadcast standards that allow transmission of depth

Open your mind to the home automation era

Ever wished you could run some of your daily chores at the flick of a switch? Well, this may soon become reality thanks to an open source home automation and networking platform from IST project Hometalk.

Hometalk set out to overcome the problems posed by existing home networking, automation and control systems that automate procedures such as turning on the washing machine. As Christos Georgopoulos, CEO of inAccess Networks, Greece, provider of a smart home gateway to the project, explains: 'For home automation service development, only closed solutions used to exist, each with a specific language

that had to be mastered by specialist technicians. This did not help the progress of the service development market and could not build a critical mass of service developers that could support the requirements of

the early adopters of the emerging home automation market.'

The project partners decided to produce an open source platform to offer more freedom to service developers. 'We offer it back in open source in order to allow for input by other parties and to quickly gain adoption by developers', comments Georgopoulos, adding that the 'target is to integrate the developer community and develop a standard base'.

Designed with the requirements of service providers and operators in mind, Hometalk is a platform from which they can offer their advanced services. The advantages include decreased development time, homogeneity such as a common language and the possibility to focus on the value-added service they offer rather than the need for interconnectivity.

The system combines previously unconnected appliances, such as a telephone and an oven, into one platform through a common reference point called a residential gateway, which has the necessary hardware interfaces and software protocol stacks to implement convergence between the different technologies. A number of systems can then be controlled from one platform to facilitate the process for user requests.

In Hometalk, traditional graphical user interfaces are speech-enabled with automatic speech recognition and text-to-speech generation capabilities to achieve a more natural user interaction. Users operate the system from a personal digital assistant (PDA) or an ordinary telephone by either

programming or dictating into the PDA the actions they want Hometalk-based systems to carry out, for example remotely switching on the oven for cooking.

Jan Sedivy, IBM Czech Republic, project manager of Hometalk, elaborates: 'The central control/automation engine of Hometalk [called Hermes] includes a scheduler... It can register alarms that the user sets directly through the telephone by performing voice recognition.' This allows the user to create various scenarios with the intelligent home devices, such as programming lights to switch off at 11.00 and on at 16.00 daily.

Connected to devices on the home network, the platform allows for easy development of services that can offer elderly and disabled persons freedom at home to carry out tasks that might otherwise be difficult or not possible. A simple 'emergency function' built on Hometalk can telephone an elderly person's children indicating that a sensor has been activated by a person falling over or if a special emergency button has been pressed. 'It explains what happened [...] by synthesising the appropriate message based on the exact situation [whilst] at the same time it talks calmly to the elderly person explaining that an appropriate person is in contact', says Sedivy.

The Hometalk platform, which has now been finalised and delivered to the open source domain online at the project website address, was trialled in Madrid, Spain (Telefónica users) and Athens, Greece (OTE users) from June 2004 until May 2005. Hometalk had already presented prototypes of the platform at 'Net-at-home 03' in Cannes, October 2003.

Promoted by the IST Results service.

http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/BrowsingType/Features/ID/64810/highlights/hometalk

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information in an enhancement layer, while providing full compatibility with existing 2D decoders. First, perceptual quality has been assessed through a software prototype, following a real-time decoder prototype that was developed and demonstrated at CeBIT.

'It was also important that the technology is adaptable to a wide range of 2D and 3D displays', says Op de Beeck.

At present, a suitable glasses-free 3D-TV display that enables free positioning of the viewer is not available. Also, there is no suitable display for single users (3D-TV on PC), or for use in a typical living room environ-

ment. But Attest developed two 3D displays (single and multiple user) that allow free positioning within an opening angle of 60 degrees. Both are based on head tracking and project the appropriate views into the viewer's eyes. Although the single user display is currently available on the market under the name 'Free2C', the multiviewer display still needs further engineering work.

To validate the progress in 3D content generation, in combination with the transmission chain (coding-decoding) and the Attest 3D displays, the project used an iterative user-centred design cycle, where end-user input was directly translated in design options to

improve the total 3D-TV recording-transmission-visualisation chain.

Attest demonstrators have been shown at large exhibitions, such as IFA, CeBIT-Europe, CeBIT-USA, IBC, to name but a few, where they helped to create awareness that the introduction of 3D-TV is already possible from a technical point of view. Recent prototypes from major EU companies, as well as interest from Hollywood directors, indicate that commercial introduction of 3D-TV is getting closer.

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http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/BrowsingType/Features/ID/77377/highlights/attest

When robots learn social skills

Learning to communicate and adapting our behaviour to the information we receive has been fundamental to human evolution. If machines could do the same, the intelligent talking robots of science fiction could become the stuff of science reality, as researchers aim to prove.

Most research into the artificial intelligence (AI) that underpins any form of intelligent machine-machine or machine-human interaction has centred on programming the machine with a set of predefined rules. Researchers have, in effect, attempted to build robots or devices with the communication skills of a human adult. That is a shortcut that ignores the evolution of language and the skills gained from social interaction, thereby limiting the ability of AI devices to react to stimuli to within a fixed set of parameters.

But a team of researchers led by the Institute of Cognitive Science and Technology in Italy are taking a new approach to the problem, developing technology to allow machines to evolve their own language from their experiences of interacting with their environment and cooperating with other devices.

'The result is machines that evolve and develop by themselves without human intervention,' explains Stefano Nolfi, the coordinator the ECAgents project, which, with financing from the European Commission's FET initiative, has brought together researchers from disciplines as diverse as robotics, linguistics and biology.

The technology, dubbed embedded and communicating agents (ECA), has allowed researchers at Sony's Computer Science Laboratory in France, for example, to add a new level of intelligence to the AIBO dog. Instead of teaching the dog new tricks, the algorithms, design principles and mechanisms developed by the project allow the robotic pet to learn new tricks itself and share its knowledge with others.

'What has been achieved at Sony shows that the technology gives the robot the ability to develop its own language with which to describe its environment and interact with other AIBOs — it sees a ball and it can tell another one where the ball is, if it's moving and what colour it is, and the other is capable of recognising it', Nolfi says.

The most important aspect, however, is how it learns to communicate and interact. Whereas we humans use the word 'ball' to refer to a ball, the AIBO dogs start from scratch to develop common agreement on a word to use to refer the ball. They also develop the language structures to express, for instance, that the ball is rolling to the left. This, the researchers achieved through instilling their robots with a sense of 'curiosity'.

Initially programmed to merely recognise stimuli from their sensors, the AIBOs learnt to distinguish between objects and how to interact with them over the course of several hours or days. The curiosity system, or 'metabrain', continually forced the AIBOs to look for new and more challenging tasks, and to give up on activities that did not appear to lead anywhere. This in turn led them to learn how to perform more complex tasks — an indication of an open-ended learning capability much like that of human children.

And also like children the AIBOs initially started babbling aimlessly until two or more settled on a sound to describe an object or aspect of their environment, thus gradually building a lexicon and grammatical rules through which to communicate.

'This is not only important from a robotics and AI perspective, it could also help us understand how language systems arise in humans and animals', Nolfi notes.

The success of the evolutionary and social learning approach taken to developing AI by the project has also been demonstrated in other trials.

In tests run at the Swiss Federal Institute of Technology in Lausanne, hordes of small wheeled robots learnt how to communicate, cooperate and self-organise to perform tasks that would be too complicated for a single robot.

'The technology could lead to robots able to carry out rescue operations by swarming over inaccessible areas to find people', Nolfi says.

Another project partner, the Viktoria Institute in Sweden, has used ECAs to develop a system called Push!Music that provides a new and innovative way to share music files over portable devices. Instead of users having to search for files for their mobile phone or MP3 player, Push!Music automatically shares files between users wirelessly as they sit in a café or pass in the street. AI decides what tracks to exchange based on the user's preferences and listening habits.

'From a communications perspective, this is interesting because it shows how different devices can be made to find ways to understand each other and their users', says Nolfi.

A similar application could be applied to the internet, where intelligent software agents could be used to intuitively search and categorise information depending on users' interests and needs.

It is in portable devices and the internet where Nolfi sees the first applications for the technology arising, although he also believes it is probable it will lead to the first robots that are really able to learn, communicate and adapt to their environment within a few years.

'This is a project with a big impact. We've managed to ground AI in reality, in the real world, solving one of the crucial problems to creating truly intelligent and cooperative systems', he says.

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Getting the feel of virtual reality

A giant leap forward in the realism of virtual reality may be just around the corner with the completion of a pioneering project to add textures, lighting effects and 'feel' to computer-generated 3D models.

Launched in 2002, the IST project RealReflect was the first attempt to use a new image acquisition technique known as bi-directional texture function (BTF) that captures the look and feel of different materials. The project aimed to develop the first comprehensive application using BTF for industrial modelling.

The project partners have geared their work toward the automobile sector, where the system could revolutionise the development of new models of vehicles by dramatically cutting costs and time. It also promises to open new possibilities in architecture, and further down the line, in computer games and other graphics applications.

'RealReflect is a major advancement over traditional virtual reality modelling, which basically relies on simplifications of reality by describing optical properties of a surface by a 2D matrix of data that does not show the real effects of lighting', explains project coordinator Attila Neumann at the Technical University of Vienna. 'Traditional virtual reality modelling, despite its name, lacks the feeling of reality and is a poor representation of it because the way things look highly depends on how they are illuminated and from what direction they are being viewed.'

By taking those two aspects — lighting and viewing direction — into account, the RealReflect system is capable of acquiring and rendering in virtual reality even the most subtle textures, from leather on a car seat and wood panelling on a dashboard to metallic paint or chrome on door handles. Textures can be acquired from physical samples and then rendered onto the 3D models.

'It is a much more powerful and demanding system than traditional virtual reality modelling, making it look real instead of simply believable', Neumann says.

That in turn brings with it additional complications. In order to be able to realistically represent textures the system requires a thousand times more data than other virtual reality modelling tools, leading the project partners to develop compression techniques for the BTF information. The compression allows the models to be viewed and worked on in real time.

'It would be pointless having all this data if it filled up your hard drive and proved impossible to manipulate', the coordinator notes.

The project also developed methods to take a small acquired sample of a material and multiply it seamlessly on a 3D model, which when viewed would show not only the texture but also its appearance under different types of illumination from different angles.

The overall result is a 3D modelling tool that permits immersive reality, especially when visualised in a CAVE, a cube-shaped vir-

tual reality simulator that users can walk into and see everything in three dimensions.

'I could go into a CAVE and sit in a car seat and see the car around me, it would be like being inside the vehicle. I could look at the finish of the dashboard, the position of the gear stick, the material used on the seats', Neumann explains.

To date, the ability to view a vehicle down to the finest detail has only been available by physically building a prototype, a long and costly process.

'When a car company wants to make a new model, around 50 prototypes of different designs are built, of those most will be rejected before the company reaches the final stage of choosing a model from maybe five examples', the coordinator says. 'With RealReflect there would be no need to produce 50 physical prototypes as they could be created and viewed virtually, requiring maybe only 5 or 10 real prototypes or even less to be produced.'

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That translates into 'enormous' cost savings for car manufacturers and reduces the time it takes to bring a new model to market. 'To date 3D models have only been used from an engineering perspective, never to actually verify what the vehicle looks like — with RealReflect that can be achieved accurately', Neumann says.

Besides displaying in detail the look of the vehicle, the system could also enhance safety by allowing designers to see the way different types of illumination reflect off its surfaces. This could, for example, allow designers to reduce potentially dangerous reflections on the windshield that may otherwise go unnoticed.

Beyond the automotive sector, the RealReflect system could also be applied to architecture, allowing architects to better visualise the appearance of materials used in construction, while offering clients the opportunity to virtually tour a building.

'In the future it could also be used in computer games and other graphics applications', Neumann notes.

The project partners are currently drawing up a commercial strategy to market the system, which could include either selling it as a full application with a user interface or as individual components.

Either way, RealReflect is likely to result in a new generation of virtual reality, one that is more realistic than ever before.

Flashing liquid experimental data

Experiments performed by a French research institute have provided valuable insight into how gases behave when accidentally released from high-pressure tanks.

Working with gases stored under high pressure poses a risk. Equipment failure or human error can lead to fast release of the gas under what is called flashing conditions. Hydrocarbons present in the gas make it flammable and severe damage can be caused to both people and property near the source.

The European Commission funded a consortium of four organisations to improve modelling tools in an effort to better manage the risk associated with flashing liquids. The

Institut National de l'Environnement Industriel et des Risques (Ineris) was charged with providing experimental data for validating the model results.

Ineris worked with two types of liquefied petroleum gas (LPG): propane and butane. Over 100 experiments were performed, varying parameters such as tank pressure, nozzle geometry and the effect of obstacles. Traditional monitoring techniques were supplemented with lasers and fast response probes.

Analysis of the data collected highlighted areas for improvement with respect to how the models deal with the source of the flashing liquid. Treatment of dispersion will also benefit from the knowledge gained, especially in the near field, which until now has been relatively neglected.

Ineris is looking to extract further value from the experimental data set and in the process help make industrial working environments safer.

Deep grinding production times

Researchers at Britain's Cranfield University pushed high-efficiency deep grinding (HEDG) to its limits with the intention of shortening production times for basic automotive parts.

HEDG is a relatively new machining technique that promises significantly higher stock removal rates than leading conventional methods such as shallow or creep-feed grinding. As such, HEDG has the potential to simplify the supply chain process and drastically reduce production times.

Materials experts from Cranfield University put HEDG to the test during a 'Growth' project aimed at increasing the competitiveness of the European automotive industry. A wheel made from cubic

boron nitride, second only to diamonds in hardness, was used to machine continuously variable transmission parts (e.g. gear shafts).

Analysis of thermal modelled data collected while modifying various grinding parameters allowed the scientists to determine the ideal conditions for maximum stock removal without exceeding the burn threshold. In addition, the challenges associated with applying HEDG to cylindrical grinding, which is critical for automotive parts, were overcome.

Stock removal rates in excess of 2 cm³ per second were achieved during the trials. Mineral oil was identified as a preferable alternative to water-based fluids for lubricating the work area, though some safety concerns must be resolved prior to use on an industrial scale. The adoption of HEDG by European auto manufacturers could prove to be an important advantage in the increasingly competitive global marketplace.

Environmentally friendly paper production

Paper specialists in France are using ozone to enhance the bleaching of softwood and hardwood pulps created with sulphur-free methods.

Until now chemical pulping practice has been based primarily on the Kraft process, which generates a significant amount of sulphur emissions. In order to rid the paper industry of this age-old stench, the European Commission funded a consortium of 10 organisations to develop and optimise sulphur-free pulping procedures.

Unfortunately, removing sulphur from the process negatively affects the ability of the pulp to be bleached. The School of Paper Science and Graphic Industries of the National Polytechnic Institute of Grenoble (EFPG/INPG) aimed to resolve this problem for both softwood

and hardwood pulps produced with the sulphur-free Novacell process developed in Sweden.

With respect to softwoods, the French scientists determined that the introduction of ozone or hydrogen peroxide into the process significantly improved brightness. The key was to maintain the degree of delignification, denoted by the kappa number, as low as possible following cooking. It was also noted that total yield increased when ozone was incorporated.

Ozone also proved to be successful in the case of hardwood pulps. The reason ozone

is so effective is that it removes hexeneuronic acids that otherwise discolour the subsequent paper products. An alternative method was also identified that calls for increasing the amount of chlorine dioxide used, but this is less environmentally friendly.

Recommendations for the specific sequence of chemical stages in the pulping process are available from EFPG/INPG.

Computer aid ensures speedy, high-quality translations

With 20 official languages and dozens more unofficial ones, there is an immense and expanding need for translations in the EU. Increasing translators' productivity is the goal of TransType2, an innovative computer-aided system that allows rapid and efficient high-quality translations.

The 36-month IST programme project drew on two of the most commonly used translation technologies developed to date: computer-assisted translation (CAT), in which human translators work in unison with a computer; and machine translation (MT), in which the computer handles the entire process. While both techniques have advantages and drawbacks, TransType2 has 'used the best of both worlds', said project manager José Esteban at Atos Origin in Spain, in January 2005.

'It's curious that people have been trying to perform automatic translations since they first sought to put a man on the moon, well, we've been to the moon but we still haven't designed a computer system that can translate texts as well as a human can', noted Esteban.

With that in mind the project partners ensured that TransType2 would place human translators at the heart of the translation process as a guarantee of quality, while providing them with a highly effective tool to increase productivity. According to Esteban, TransType2 is one of the most advanced computer-assisted translation systems developed to date, combining the quality-enhancing features of CAT with the productivity gains of MT.

The system works by providing translators with suggestions to complete sentences as they type which can be incorporated simply and rapidly, reducing the number of keystrokes needed to complete a translation. The suggestions are created based on models of translated texts, used by the MT engines to predict the words and phrases that will come next.

'Most existing CAT systems, and the ones most widely commercialised today, are based on translation memories with the system recording previous sentences translated by the translator and offering them or similar combinations', explained Esteban.

On the other hand, the automatic translations provided by MT systems have 'generally not lived up to expectations', the project manager noted. 'Many translators find it harder and more time-consuming to correct automatically translated text than to translate it manually from scratch', he says.

Based on the work of two previous projects, TransType (Canadian government-funded) and EuTrans (EU-funded), TransType2 offers significant benefits over existing techniques. Trials conducted at the time with two translation agencies in Canada and Spain appeared to show better results than the project partners first expected.

'We originally thought the system would increase productivity by between 15 or 20 %, but in some cases we're seeing gains in excess of 20 % and as high as 25 or 30 %', Esteban said. 'Once translators have familiarised themselves with the system the productivity increases start to become noticeable almost immediately.'

Though often wary of computer-based translation methods, the translators involved in the trials have reacted 'very positively' to TransType2 principally because they see that it speeds and eases their work while maintaining them as the core actor in the translation process. Human translators can either accept the suggestions of the system or ignore them by simply continuing to type, thereby ensuring that the system does not introduce additional complications to their work.

The TransType2 prototype was designed to assist translations from English to Spanish, German and French, and vice versa, although additional European languages can be incorporated relatively simply. 'To add Chinese or Arabic, for example, would take more research but it is possible', Esteban said.

TransType2 is adapted to the type of texts being translated, with the translation engines customisable to meet the needs of agencies that are dedicated to different types of translations, such as legal and political texts or scientific and technical ones.

'Literary documents are the most difficult to translate and where these systems have the greatest limitations given the wide range of variables in the language used in such texts', Esteban said.

Even so, the need for scientific, technical, political and legal translations in Europe is vast, so much so that demand is outstripping the resources of translation agencies.

'We're a small continent with multiple languages, the EU alone has 20 official languages spread across 25 countries and the need for quality translations is increasing rapidly', the project manager noted.

After the end of the project, the seven partners were planning to continue to develop the system with a view to commercialising it either as an individual product or as a service.

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Promoted by the IST Results service.

http://istresults.cordis.europa.eu/index.cfm/section/news/Tpl/article/BrowsingType/Features/ID/73666/highlights/TransType2

Methodology for configuration in industrial product lines

The ConIPF methodology provides a new way for knowledge-based product derivation in the context of software product families.

The ConIPF methodology addresses software engineers that deal with the complexity of huge amounts of highly variable and interdependent software and hardware components through the methods of knowledge-based configuration.

It is presented in two parts. The first part presents the activities of the engineer who develops individual products (application engineer) while reusing those components. ConIPF supports the application engineer

with automated derivation performed by the underlying tool chain. The second part presents the activities of the engineer (domain engineer) who designs and implements the infrastructure used by the application engineer. ConIPF builds a configuration model reflecting the asset store and keeps it synchronised with the assets.

To our knowledge, the ConIPF methodology represents the most comprehensive integration of software product-line engineering and

knowledge-based configuration technologies available to date. Furthermore, the ConIPF methodology is highly relevant for product derivation in the future. It addresses a rich set of different scenarios and roles and structures the product derivation process in applicable parts. Application engineering is therefore accelerated by additionally deriving correct and complete products. The ConIPF methodology will be published as a book.

New enzyme with xylanase activity

A Belgian research centre has developed an enzyme with xylanase activity at acidic pH. Many industrial processes in the pulp and paper sector or in the agrofood sector require such enzymes to improve their performance and yield.

Xylanases are enzymes used in various industrial areas such as the pulp, paper, feed and bakery industries. Other applications lie in the juice, wine and beer sectors. They can also be used in the wheat separation process. The observed technological effects are, among others, improved bleachability of the pulp, decreased viscosity of the feed or changes in dough characteristics. In

particular, xylanases have been proposed for the pulp and paper industry for delignification purposes as an alternative to chemical bleaching agents such as chlorine and its derivatives.

A Belgian research centre has developed a novel enzyme with xylanase activity at acidic pH, identified by its amino acid and nucleotide sequence and variants thereof. Its biological properties and optimum of activity are well suited to a recently introduced industrial method for pulp bleaching. The latter has the advantage of increasing the performance of the bleaching process by biological means, which are respectful of the environment and avoid the generation of toxic by-products consequently to the use of chemical techniques. More specifically, the identified xylanase is of fungal origin and presents enhanced thermostability.

In order to prevent noxious environmental impacts, xylanases are commonly used in transformation industrial processes such as pulp bleaching. For that purpose, new enzymes with xylanase activity, especially at acidic pH, are needed.

Remarkably, the present xylanase could be used in different kinds of industries. Some direct applications include the following.

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- It is particularly suited as a bread-improving agent. This class of agents are products that could improve or increase texture, flavour, anti-staling effect, softness, crumb softness upon storage, freshness and machinability, volume of a dough or of a final baked product.
- This enzyme can be used for degrading the wheat cell wall components. Particularly, the degradation activities lead to a decrease of the flour viscosity in the presence of water. This xylanase can thus advantageously be used for separating components of plant cell materials such as cereal components.
- This xylanase can help to improve the filtrability or decrease the viscosity of glucose syrups obtained from impure cereal starch. It can also be used in beer brewing when cereal has to be degraded to improve the filtrability of the wort or to re-use the residuals from beer production, for example for animal feed.
- This enzyme can be useful for extracting oil from a plant material such as the corn oil from corn embryos. Furthermore, it can improve the yield of fruit and vegetable juice processing. It can also be used in all processes involving plant materials or waste materials, e.g. from paper production or agricultural wastes such as wheat straw, corn cobs, nut shells, grass, vegetable hulls, spent grains and sugar beet.

Making tyres greener

Environmental concerns are starting to shape the face of many industrial sectors. The production processes involved in the manufacture of tyres and technical rubber goods have come under examination with a view to improving their environmental record.

The EU-funded Satpro project focused on the analysis of these production processes in light of the availability of new materials and how these might affect tyre manufacture. The emphasis was placed on the 'green tyre' formulation and the requisites for its production.

The key reaction in this entire process is what is termed silanisation, intended for the production of tread compounds for silica-based tyres. Silanisation is defined as the chemical grafting of organic molecules via a trichlorosilane group. Project partner ThyssenKrupp Elastomertechnik developed an innovative silanisation reactor for the rubber industry, which could revolutionise the manufacturing of rubber goods.

There are distinct advantages associated with the use of the reactor, since reaction times are reduced and conditions can be more easily controlled. Currently these reactions are carried out using internal mixers, which are not specially adapted to silanisation steps. The new reactor can be easily integrated into existing mixing lines and carry usual mixing loads as the conventional internal mixers.

ThyssenKrupp Elastomertechnik is seeking to form collaborations with interested stakeholders in the field in order to exploit the potential of this innovation at all levels.

New technology draws in the animators

New software will unleash new artistic tools for animators, enabling graphic styles never seen before.

Despite huge advances in the art and science of animation in recent years, led notably by box-office phenomenon Pixar studios in the US, creators of *Toy Story*, *Monsters Inc.*, and *The Incredibles*, many graphic styles are still impossible to render.

For example, highly stylised strip cartoons found in comics and graphic novels are almost impossible to animate. '[It's] because of a lack of frame-to-frame stability and [it] proved an absolute limitation to the scope of drawn animation', says John Patterson, coordinator of the Custodiev IST project and senior lecturer of the Department of Computer Science at Glasgow University.

'The strip-cartoon effect cannot be mimicked in 3D animation because the 3D model forces its unique geometry while in drawn animation the artist can, and routinely does, cheat geometry, and just about everything else to achieve a minimally constrained sense of the realised world', says Patterson.

But the Custodiev software not only enables new effects, it also lowers costs on standard production processes. For example, Custodiev developed a tool that can automate 'in betweening'.

In-betweening is a vital, though little known, animation process. It captures the transitory moment between two positions. As a character moves from one position to the next, in-betweening creates the illusion of a smooth progression from one frame to the next. It's a difficult and time-consuming task that requires great skill.

'When we talked to our user groups about doing the obvious thing in animation, namely automating the in-betweening process, they mostly hated the idea because it robbed them of control and denied them the opportunity for their favourite tricks', says Patterson, but, he adds, the artist can use it or not.

Costs will come down, too, as artists become more expert with the new tools. 'On the one hand the artists are learning fast new tricks with the new tools, so their production costs will come down all the time this is happening, and at the same time their range of skills within the new medium is expanding. On the other hand we are learning how to structure the interfaces to eliminate the most immediate constraints to the flow of production so at some later stage there will be a further reduction in production costs when we feed this back in, but this will only come out of our end-of-project evaluations,' says Patterson.

The project is also looking at other tools, such as electronic paper-like e-Ink. This gives a 'paper-like' feel to using computer animation and is highly favoured by artists, Patterson says.

Initial public exposures of the new tools at the 'Masters' series run by Cartoon/Media prompted consider-able interest from animators and production houses. 'We expect to see this continue at our next demonstrator conferences — Cartoon Future and our user-group demonstrator', says Patterson.

The next stage for the group, with partners which include animation studios, is to pitch a film project that can take advantage of the new techniques. 'The film will be our ultimate advertisement', says Patterson.

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INDUSTRIAL TECHNOLOGIES
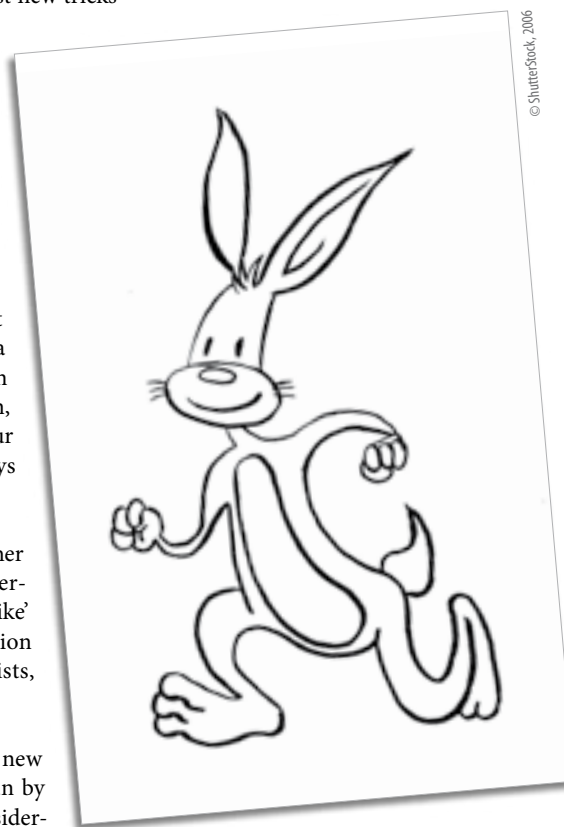
Mechanical masks for advanced nanofabrication devices

Aiming at developing and exploiting advanced nanostructure generation techniques, the Nanocold project focused on microfabrication of mechanical masks for massive parallel nanolithography.

On the basis of the deposition of atoms focused by laser beam, atom lithography nanotechnologies have been developed for the accurate fabrication of nanostructures in the 10 nm range. Particularly interesting is atom lithography of group III materials, such as In and Ga, two key elements for many electronics, optoelectronics and information technology applications.

One of the major Nanocold project results was the development of mechanical masks that allow massive parallel deposition, which results in high-quality nanostructures. More specifically, newly developed procedures are capable of both serial and parallel fabricated working devices that enable shadow deposition of cold atom material on a sub-300 nm scale.

The clogging issues identified under previous research work were studied in detail and it was shown that they can be controlled. Moreover, these problems can be significantly minimised when using suitable geometries of the mechanical masks. The masks have been tested on atom species, but they also show increased potentialities for application on molecules and polymers.

The developed shadow masking devices can define structures on a sub-100 nm scale through evaporation techniques using open apertures. This would allow definition of arbitrary structures on the same scale by scanning the device with piezotranslators. Partners interested in using deposition of material through sub-micron shadow masks for application of building structures in a bottom-to-top manner are sought for further collaboration.

Laser tech promises semiconductor gains

A special laser technology could result in a major breakthrough in the manufacture of complementary metal-oxide semiconductor (CMOS) devices. The process, known as excimer laser annealing (ELA), could mean smaller and much more efficient semiconductor transistors.

The FLASH project, funded under the 'Future and emerging technologies' (FET) initiative of the European Commission's IST programme, sought to establish the feasibility of ELA for 70 nm CMOS fabrication, and to produce software to simulate the interaction of the laser beam with a silicon device.

The semiconductor industry uses annealing to introduce dopant atoms into the silicon crystal lattice. A dopant is simply an impurity added to the lattice. This causes drastic changes in the electrical properties of the semiconducting material. Currently annealing is generally performed by lamp-based systems.

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The excimer laser uses a dimer, a molecule composed of two similar subunits or monomers linked together. The advantage of using an excimer in the annealing process is that, if it can be scaled up to a production level process, it could heat the silicon much faster, in the space of nanoseconds, to the point where the silicon melts.

'And when the silicon melts, the dopant diffuses through it evenly and stops at the melt depth', says Dr Vittorio Privitera, a senior researcher at Italy's CNR-IMM and the FLASH project coordinator. This gives greater control of the process and enables the creation of more efficient transistors which require less energy to run. Laptops using this type of CMOS device could potentially run 50 % longer.

'Of course, the semiconducting industry gets very nervous when you start talking about melting silicon', says Privitera, 'so we had to prove that the technique worked, that it did not damage the CMOS device, and that it could produce an industrial lead.'

For that, the team first examined the feasibility of ELA for high-yield production. 'We built a prototype and we used mirrors on the silicon to protect the areas that we did not want to melt', he says.

The team found that their system could produce very shallow source/drain junctions, extremely well defined channels, and even very short channels. This is a very difficult level of accuracy to achieve in an industry governed by microns and nanometres, but the excimer laser is an extremely powerful and accurate tool.

The team also developed a 2D simulation programme, called Class, which shows the distribution of heat, or where the silicon melts, and the diffusion of dopants.

'We could show that there was no lateral diffusion of the dopant, that we only altered the silicon where we intended to', says Privitera.

The team finished the project in December 2005, but work is continuing on the project. 'We still had reports to write up, and two patents are pending on the materials we developed', he adds.

Laboratory work will also continue, however. 'At the very end of the project we just put the finishing touches to the most advanced, accurate and efficient prototype that we developed, so we didn't have time to get all the results we want out of this final prototype. We did achieve all we set out to do, but we want to continue work with this state-of-the-art prototype we developed to see just how far we can push this technology', ends Privitera.
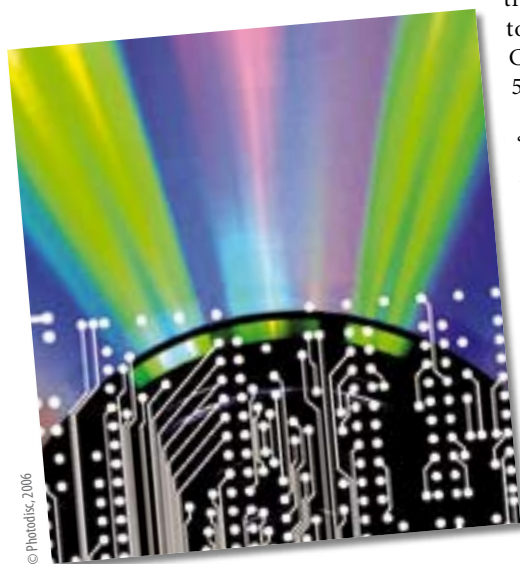
Guide to biotechnology in Poland published

A new biotechnology atlas of Poland will help researchers and businesses across Europe find partners in Poland.

Produced by German biotech network Bio-Con Valley, the atlas provides an overview of the Polish biotechnology sector, as well as profiles of 109 life science companies and 43 research centres in the country.

'Internationality is a basic requirement for companies in the biotechnology and life science sectors to achieve and maintain competitiveness', said Dr Heinrich Cuypers of BioCon Valley. 'We see considerable potential on the Polish Market. Through the sector atlas we hope to facilitate co-operation for our businesses.'

According to the atlas, the main strengths of the Polish biotech sector are in the fields of R & D, with a focus on medicine, pharmacy, plant and animal breeding and environmental biotechnology. It also has a strong education system, with 21 Polish universities offering courses in biotechnology and related disciplines. Its legislation, in particular the 'gene law', is also favourable to biotech research. However, the field is being held back by limited investment and a lack of biotech-specific infrastructure, in the form of science parks and incubators.

Based on press information from the ScanBalt BioRegion.

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New publication will help scientists reach out to public

The European Commission has published a 'survival kit' to help scientists communicate their activities to the public more effectively.

With issues such as bird flu and global warming regularly hitting the headlines, improving the public's understanding of science is increasingly important. Furthermore, where research has been publicly funded, people may be interested to know how their taxes are being spent.

Communicating science: a scientist's survival kit delves into the world of science communications, and teaches scientists how to reach out to the public and compete for their attention. Combining general theories with tricks of the trade, the kit provides useful information on how to plan communications activities, explain complicated research in simple terms and use different forms of media.

Based on the publication 'Communicating science: a scientist's survival kit'.

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Best of United Kingdom research highlighted

As the government of the United Kingdom continues to discuss the future shape of research assessment and funding, Universities UK has produced a book celebrating 50 years of life-changing research in the country.

The publication, *Eureka UK*, highlights 100 major discoveries, developments and inventions by academics at universities in the United Kingdom, and covers the medical, physical and social sciences as well as the arts and humanities. Included in the book are the unlocking of the DNA code, the first programmable computer, the discovery of pulsars and artificial cows combating disease in Africa.

'Who can imagine a world now without CDs and DVDs, test-tube babies, or computers? None of these would have been possible without the work and dedication of academics in the United Kingdom', said Dianne Warwick, chief executive of Universities UK. 'We need continued investment from government and industry if we are to maintain our high standards and see similar groundbreaking discoveries at our universities over the next 50 years.'

In particular, the authors hope the examples used will demonstrate to research funders both the unpredictable nature of research, and the length of time it can take to measure its success.

Universities UK will distribute the publication to secondary schools, with the hope that it will spark an interest in discovery and inspire young people to go to university.

Based on information from Universities UK.

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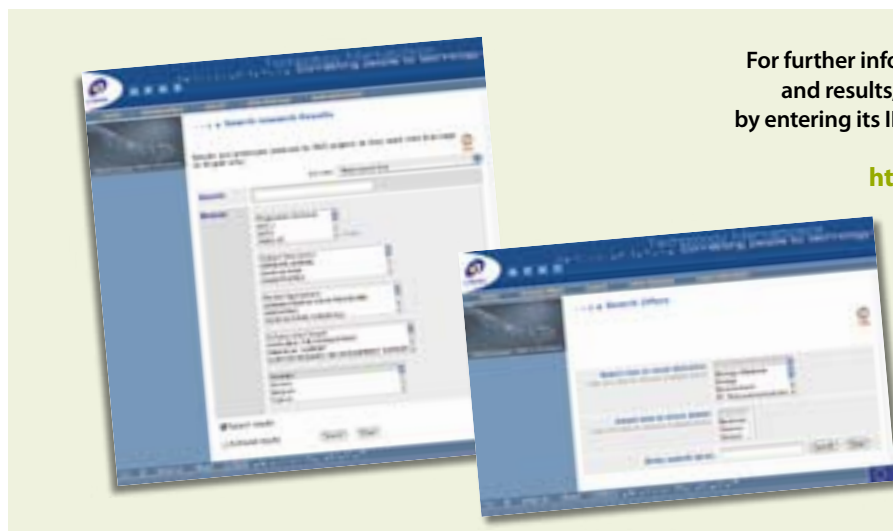

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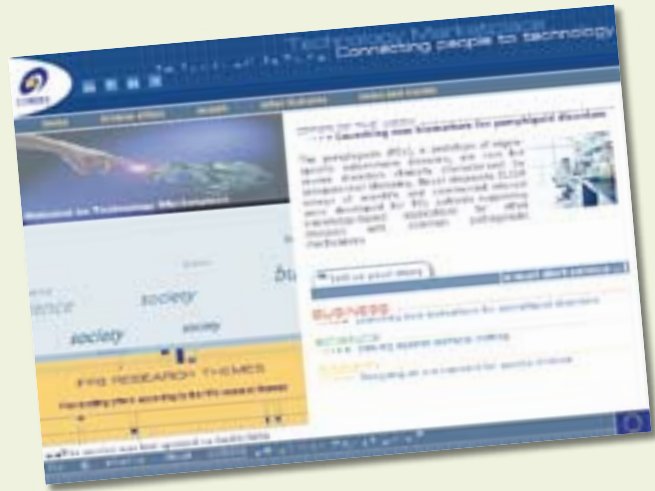
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