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SPECIAL FEATURE

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ENERGY AND TRANSPORT

CONSTRUCTING ENERGY-EFFICIENT SCHOOLS FOR THE FUTURE

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RESULTS MAGAZINE

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EDITORIAL

by the editorial team

HUMAN MACHINE SYMBIOSIS: COULD THE SINGULARITY BE MORE THAN A FANCIFUL THEORY?

Raymond Kurzweil is probably one of the most inspiring computer scientists and futurists of his generation — with a career paved with head-turning innovations, prestigious awards for his inventions and a place in the US National Inventors Hall of Fame. However, his legacy will mostly be that of a curious prediction: Kurzweil believes that, in around 2045, machines will outsmart people to the point where they can actually improve themselves without any help from their human designers.

According to some theories, that event might actually mark the moment when humans and machines merge with each other. Humans would then be blessed with the likes of eternal life and intellectual and physical capacities beyond imagination.

Some 30 years separate us from the potential realisation of this theory. So the question is, are we getting any closer to that point? Are scientific efforts to produce more human-like machines and blur the lines between virtual and 'real' reality proving to be fruitful? This edition of the *research*eu results magazine* is shedding some light on this issue by presenting some of the latest achievements of scientists thanks to EU funding.

'We could be tempted to conclude that Kurzweil's theory is all but far-fetched.'

Judging by the discussions we had with the coordinators of the 11 most recently active projects in this field, we could be tempted to conclude that Kurzweil's theory is all but far-fetched. These projects can be split into three categories: efforts to bring human-machine interaction to the next level thanks to advanced brain-computer interfaces, research tapping into brain functioning to inspire a new generation of machines and algorithms, and near-science-fiction technologies that could eventually make virtual reality as real as anything we humans can experience in our daily life.

This special feature is followed by the usual eight sections providing insights into biology and medicine, social sciences and humanities, energy and transport, the environment, IT and telecommunications, industrial technologies, security and safety, and space, along with a list of upcoming events hosted by or involving EU-funded research projects.

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

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Fish or seafood: feeding humanity while maintaining nature's balance

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INTERVIEW

TOUCH AND FEEL OVER DISTANCE: THE NEXT TREND IN ICT?

Tactile displays may have changed the way we interact with technology, but this is a mere evolution compared to the true revolution that is now underway. Soon, haptic feedback could allow technology enthusiasts to interact with a remote object or person, as if they were physically in its presence.

Haptic communication is often considered one of the next breakthrough technologies in human-computer interaction, and also allows for more in-depth interaction between users over distances. However, whilst the topic of haptic interaction via a 'Human-machine interface' (HMI) has been around for quite some time, there is still a lot of work to be done to find suitable methods and technologies for the efficient processing and communication of haptic signals.

Enter the EU-backed PROHAPTICS (Haptic Signal Processing and Communications) project. Over the past five years, Prof. Eckehard Steinbach from TU Munich and his team have been developing a series of novel methods and technologies for haptic communication. In this exclusive interview with the *research*eu results magazine*, he discusses his expectations for the future of this relatively new field of research, some potential applications and his plans to further develop the technology now that the project has come to an end.

★ How do you see haptic communication progressively taking over the ICT market?

Prof. Eckehard Steinbach: One of the main application scenarios considered is teleoperation with haptic feedback, where a user interacts with a remote environment through the HMI. In this context, the user remotely controls a robotic system typically equipped with sensors and actuators. The interaction forces/torques are captured when the teleoperator is in contact with the remote objects, and they are reflected back as haptic feedback to the operator.

This way, the user is able not only to see and hear what is going on in the remote space, but also to feel the interaction. Numerous studies have shown that haptic feedback improves task performance and the feeling of being present. The long-term goal of this research is to make the teleoperation fully transparent, which means the user will no longer be able to tell if a task is carried out locally or remotely through the HMI.

This research is complemented by investigations about tactile displays and tactile feedback, which for instance allow a user to feel the roughness of an object surface via the HMI. Major steps have only recently been taken to also enable standard mobile devices such as smartphones to generate haptic feedback. It is already technically possible today to locally modulate the friction between the finger and the glass display of a mobile device in such a way that tactile patterns or textures can be displayed. This, in my opinion, bears tremendous potential for new types of applications which allow a user to explore objects over the internet, not only visually but also haptically.

PROF. ECKEHARD STEINBACH

★ What can the concrete benefits of human-to-machine interaction based on haptic communication be?

In our daily life, we as humans rely heavily and constantly on the haptic modality when interacting with our environment. Without manipulation capabilities and haptic sensing, this interaction would be extremely limited. So far, however, physical interaction happens only locally in our direct vicinity. With appropriate haptic HMIs and haptic communication approaches, this interaction can also be enabled across barriers such as distance or scale.

Haptic interaction and communication of course also comes with great potential for the visually impaired. A lot of useful information can be communicated through the haptic modality.

★ Can you give a few examples of applications that would be conceivable within the next few years?

The aforementioned teleoperation systems are already in use and support applications such as telesurgery, telemaintenance, etc. With new haptic interfaces emerging, in particular tactile displays, completely novel applications become possible. Just imagine a web store where the user can not only visually explore a product but also touch it before buying it. Or imagine that your spouse is in a furniture store and sends you a photo of a sofa he/she would like to buy. Wouldn't your first question after seeing the photo be what the material feels like? Is it soft, warm, comfortable?

With haptic communication, you could for instance slide your smartphone over the surface of the sofa, record the resulting vibration signal using the built-in acceleration sensors, compress and transmit the signals and eventually display them remotely. This way a remote haptic experience becomes possible. If you don't like this particular material, you could then search in a database for other materials which are similar or which have a specific 'feel'.

Another application would be an improved video conferencing system where you can haptically interact with your children while being on a business trip. Through these systems you could comfort them and be more present than is possible with today's solutions.

★ How is PROHAPTICS an important step towards such applications?

PROHAPTICS has developed a series of algorithms, codecs and protocols which enable haptic communication across distances for both haptic modalities (kinesthetic and tactile). The solutions developed are human-centric in the sense that they consider and exploit the limitations of the human haptic perception system. This way, information that cannot be perceived does not have to be transmitted. The resulting haptic communication schemes are highly efficient with respect to the communication resources required and can be used for both remote interaction with a real environment and a virtual environment. We have also proposed solutions which allow multiple users to physically interact with the same object in a virtual environment in a coherent and natural manner.

★ What would you say are the main contributions of your research to the main issues currently faced in this field?

We have been among the first to address the topic of haptic communication from a technical / communication engineering point of view. Some of the approaches we have proposed are first-of-their-kind and I hope it is fair to say that we have significantly advanced the state-of-the-art in this emerging field.

An example of this is the perceptual deadband coding approach that we have proposed for data reduction in haptic communication. This coding approach works for haptic signals with multiple degrees of freedom. It has also been combined with passivity-based control architectures and hence can also be used in networked teleoperation scenarios where the communication delay between the two sides jeopardises system stability.

★ Can you tell us about the mathematical model you developed?

This model combines many of the known limitations of human haptic perception with some other limitations that we have initially described in a common framework, which can be used to decide if a haptic signal change is perceivable by a human or if it stays below the perception threshold.

Based on this model, highly efficient data reduction schemes can be designed. Another application of the model is the definition of objective quality metrics, which replace (at least partially) the need for costly and time-consuming user studies. Hopefully, these approaches will accelerate the progress in this field.

★ Now that the project is completed, do you have any further plans to exploit or build upon its results?

Yes, together with two of the PhD candidates involved in the PROHAPTICS project, we are currently investigating how to commercialise selected results and working towards a start-up company in this area. We are in the fortunate situation where our related ERC Proof of Concept application ROVI has been selected for funding. This will allow us to get a better idea about the market potential of our results over the next 18 months and to produce prototypes in close collaboration with potential customers.

PROHAPTICS
★ Coordinated by TUM in Germany.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/97511

NEW DISCOVERIES AND ENHANCED VISUAL EXPERIENCES THROUGH GAZE-CONTINGENT DISPLAYS

The EU-funded DEEPVIEW project has shown that innovative displays with gaze-tracking devices can enhance a viewer's perception of depth, allowing greater exploration of an object of interest.


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Researchers are creating innovative displays that allow users to explore focus, depth, colour and new ways of presenting information, simply by tracking their gaze across the screen. The user's gaze alone is enough to direct focus and also enhance depth perception and distinguish colours better — without the need to click on a cursor to call up data or focus on the object they are interested in.

Innovative GAZER software

GAZER is the first application to come out of the DEEPVIEW (Gazed-based Perceptual Augmentation) project carried out by SACHI, the Computer Human Interaction Research Group at St Andrew's University in Scotland, UK. The software, developed following tests on over 50 different users, works in conjunction with eye tracking devices to allow photographers taking pictures with light field cameras to explore images by automatically focusing on objects using just their eyes.

'We are exploring the potential uses of an exciting new area called gaze-based perceptual augmentation,' explained DEEPVIEW coordinator Dr Miguel Nacenta. 'Instead of moving a cursor around to focus, the "Gaze-contingent display" (GCD) does it automatically through the position of the user's gaze. This creates a sensation of depth, 3D without the glasses if you like — a richer, more salient and natural way of seeing that is meant to enhance the viewer's experience.'

The use of GCDs

A GCD works by modifying the information gathered from the eye-tracker about the user's gaze. This covers not just its location, but also other metrics such as blinks, fixations and saccades. The aim is to do this in a way that does not allow the user to perceive the system reacting to his gaze. Instead, it creates a holistically changed impression of the display.

In the past, this technology has mostly been proposed for performance gain (i.e. improve computer rendering times) by selectively omitting details in unattended parts of a display. DEEPVIEW's goal, however, is to find perceptual modifications that augment the information displayed and thus create an enhanced viewing experience for the user.

The project is investigating the use of GCDs in other ways too, such as enhancing perception of colour and contrast, and for multimedia applications. Enhancing colour, so the user perceives a wider range than the monitor is capable of displaying, could in future become a highly useful tool, for example, in big data analysis.

In applying the technology to multimedia, users reading an article might unconsciously call up all sorts of complementary information offered — graphs, photos, videos, supplementary text — as they scan the text paragraph by paragraph.

'The key will be to do this so that the reading experience is enriched, not disrupted,' Dr Nacenta pointed out. 'In fact, using gaze perception technology promises to be less disruptive than pointing and clicking on a cursor. You can take advantage of the natural behaviour of people looking at things, rather than asking them to interact explicitly with the system.'

Other possible uses for GCDs

The sky is literally the limit as far as gaze-based perceptual augmentation is concerned, as DEEPVIEW is also looking towards astronomy.

'Astronomers sometimes need specific colour and depth in their work,' said Michael Mauderer, a doctoral student working on the project and the main developer of the GAZER application. 'They look at these very complex images they get from telescopes which go from infrared to ultraviolet, exceeding human vision bandwidths. We are working to help them view such data in a different way, which could eventually lead to new discoveries.'

The use of GCDs may eventually become widespread, according to Dr Nacenta, whether for enhancing cinematic experiences, giving doctors a better interpretation of patterns in magnetic resonance images, or helping police solve crimes from sketchy CCTV images.

DEEPVIEW, which began in June 2012 and ends in May 2016, received a Marie Curie action grant of EUR 100 000 from the EU's Seventh Framework Programme.

DEEPVIEW

- ★ Coordinated by the University of St Andrews in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/news/rcn/124881

BRAIN-INSPIRED NAVIGATION IN ROBOTS

Could the human brain inspire a new generation of robots able to navigate in complex and unpredictable environments? The GRIDMAP project is trying to unravel its mysteries and translate them into a new generation of algorithms in order to find out.

Computers are undoubtedly a step ahead when it comes to processing enormous amounts of information with precisely-instructed algorithms and within short time-frames. However, to this day they still lack the capacity to efficiently compute ambiguous and unpredictable data: the latter requires the algorithm to be updated frequently, something that only the human brain — which is known for being about 30 times more powerful than the best computer chip — is able to do efficiently.

One of the best examples of this computer limitation resides in navigation. Whilst our brain can easily help us navigate through dynamically changing environments, 'Simultaneous localisation and mapping systems' (SLAMs) will perform poorly, especially when taking into account the tremendous amount of computations and memory involved in the process.

'In traditional computers, much of this process is serial, in the sense that the computer will do one thing at a time,' says Dr Edvard Moser, coordinator of the EU-backed GRIDMAP (Grid cells: From brains to technical implementation) project. 'In the brain on the other hand, many processes take place at the same time and it's all interactive: what takes place in one region of the brain takes into account what is going on at the same time in another region.'

This is where Dr Moser's most documented discovery comes into play. In 2005, he and his team at the Centre for the Biology of Memory (CBM) in Norway discovered grid cells, a type of neuron in the brains of many animal species that allows them to understand their position in space. The main premise of GRIDMAP is that this process can be studied, translated into algorithms and integrated into machines to enable brain-like navigation in complex environments.

'We wanted to know more about how the brain works,' Dr Moser recalls. 'We started by studying the brain, thinking that its processes could also be used in computers, and especially robots. The idea was that if we could know more about the mechanisms behind brain navigation, what types of cells are involved and how they work together, this could then be used by engineers who produce artificial systems such as robots to advance the state-of-the-art.'

In its first phase, the team focused on studying how grid cells work together. 'For example, if a rat is walking in a box 2 m², its brain cells may be active in 10-12 different locations. From thereon in, there is a complex process taking place that involves a lot of physics, but the bottom line is that these active cells compete with each other and that the activity pattern emerges as a result of this competition. It emerges because it is the most stable pattern,' Dr Moser explains.

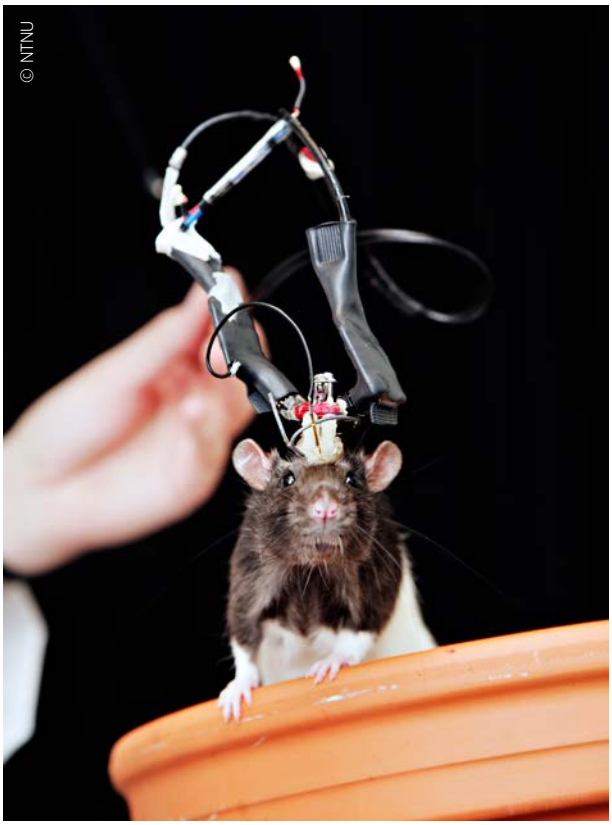
Since the project began in March 2013, the team have been using a measurement tool to better understand this process. They recorded the electrical activity of animal brain cells with electrons that capture ongoing electrical activity without damaging the cell, and then recorded this information on a computer in order to determine how the cells work together to form a map of the environment surrounding the animal. 'For that work, we collaborate with computation specialists in order to develop models of how things could work. Those models are basically predictions, so we check if those predictions are right, and then, depending on the outcome, the models are adjusted,' says Dr Moser.

From brain to machine

This long research process, which was originally scheduled for completion in August 2016, will last for at least another year. Dr Moser and his team have recently been granted a one-year extension for GRIDMAP, which will provide them with the time needed to successfully conduct the technical implementation phase.

'We are now trying to implement connectivity patterns, similar to the ones we observed in the brain, into computers and then see if, somehow, that enables robust navigation in robots. But there is still a long way to go if we want to understand precisely how the brain works and how to implement these mechanisms into machines,' Dr Moser says.

'What is needed is a technical implementation of a situation where a robot finds its way in an environment where many unexpected things happen, for example the need for taking an improvised shortcut to avoid an obstacle in an unknown environment. We are looking at such situations in animals too, but still it is hard to figure out. Moreover, the progress in biological research is much slower than perhaps what the robotics industry would expect. I think drawing inspiration from biological processes is the right way to go, but it takes time.'



Dr Moser and his team very recently started to implement some of the principles they found in brains into computers. While he says that the results already look promising, he admits that the point where GRIDMAP translates into commercial products is far from being reached. The research will most likely continue after the end of the project, but he believes this will eventually prove worthwhile: navigation is one of the properties that the robotics industry is most interested in, and GRIDMAP is presenting them with more potential than any alternative.

GRIDMAP
★ Coordinated by NTNU in Norway.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/106314

INTERVIEW

MYOELECTRIC DEVICES MEET SENSORY-MOTOR INTEGRATION

One of the key features missing in current myoelectric prostheses is sensory feedback — the sense of touch so crucial to our interaction with everything that surrounds us. An EU-funded consortium has overcome this difficulty and is already bringing its devices to market.

The most difficult and crucial phase of any research and development process is undoubtedly the transition from academic research to products answering commercial needs. This can notably be observed in the market of myoelectric interfaces. While the latter have various advantages over body-powered prosthetics — including their use of suction technology and the use of electronic sensors to detect minute muscle, nerve and 'electromyography' (EMG) activity and translate it into movements — commercially-available devices still lack the capacity to provide their user with sensory feedback.

On the academic level, however, myoelectric interfacing with sensory-motor integration is already feasible. All it would take for this possibility to result in actual products is a two-way transfer of the knowledge in basic neurophysiology research and signal analysis from academia to industrial sectors, and of the requirements of and testing for clinical and commercial viability from industry to academia.

This is where the MYOSENS (Myoelectric Interfacing with Sensory-Motor Integration) project comes into play. Helped by a consortium of internationally regarded European academic teams and industries, Prof. Dario Farina from the University of Gottingen has spent the past four years working on solutions to implement sensory-motor integration into commercially-viable myoelectric devices.

The project, which ended in March 2016, is the first-ever research effort to focus on two aspects: training for the active control of prostheses, and rehabilitation of stroke patients thanks to robotics. These two areas require a similar technological ground for sensory-motor integration and for artificial induction of neural plasticity, necessary for (re)learning motor tasks, and the consortium's efforts are already translating into novel, commercially-available products.

★ How do you explain the absence of sensory-motor integration on current interfaces?

Prof. Dario Farina: Sensory-motor integration is missing in commercial/clinical interfaces because the systems developed in research laboratories are not yet robust enough to be implemented in clinical devices for daily use. Moreover, it is not yet fully clear if sensory feedback in rehabilitation devices is useful.

For example, while it is obvious that providing some kind of feedback to prosthetic users is useful when all other sensory information is removed, it is much less certain that additional feedback is functionally useful when the natural feedback that amputees maintain (such as vision) is preserved.

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

The project (IAPP type) consisted in translating concepts developed in academia to industry and vice versa. The main difficulty was designing experimental paradigms to compare objectively different solutions for providing artificial feedback to prosthetic users.

Solutions include different feedback modalities (e.g. electrical stimulation, vibration), different feedback locations (single or multi-site), different feedback variables (e.g. force, speed), and so on. Understanding the best combination of these variables empirically is very challenging and cannot easily be generalised.


© Dario Farina

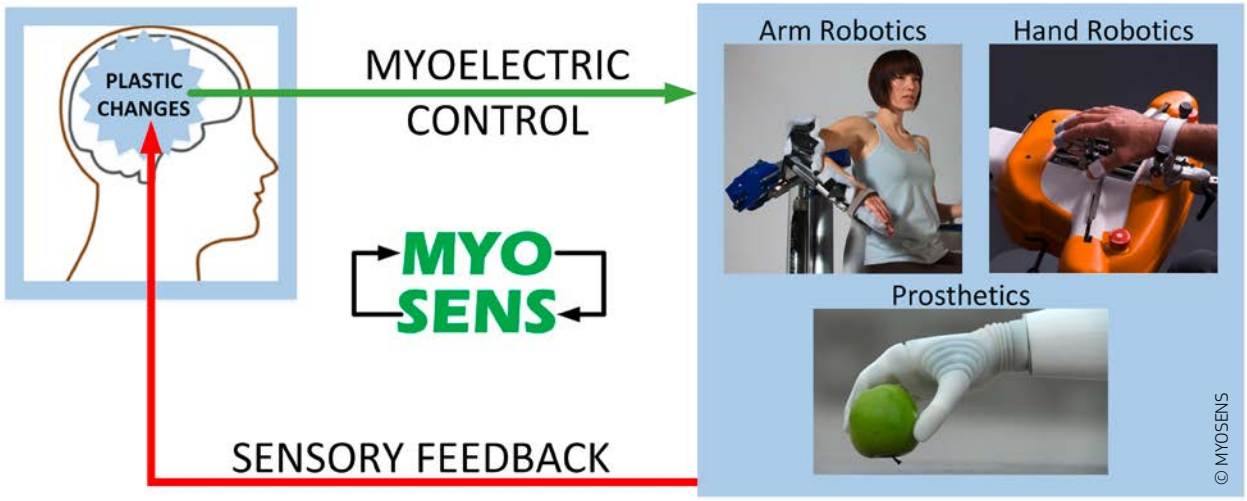
PROF. DARIO FARINA

Therefore, a theoretical model was developed that could predict the outcome based on fitting parameters in a few experimental conditions.

★ You specifically chose myoelectric prosthetic control and motor function rehabilitation of stroke patients as applications. Why this choice?

These are two important areas for clinically-viable rehabilitation technologies. Prostheses controlled by myoelectric signals are already on the market (although without sensory feedback) and similarly robotic devices for rehabilitation are available to patients (although without myoelectric control).

The two technologies were missing complementary aspects, the sensory feedback and the motor commands



respectively, and therefore were representative of the problems we outlined.

★ Are you happy with the project results so far?

The project had extremely satisfying results. The most relevant is probably the introduction into the market by Tyromotion, one of the companies participating in MYOSENS, of one of their robotic devices with the inclusion of the myoelectric control we developed within the project. This can have a strong impact in translational research.

Another system developed during the project for the reduction of phantom limb pain in amputees with sensory feedback is being patented. The project also provided important insights into the role of artificial sensory feedback in prosthetics, which can be used as guidelines to implement effective and practical feedback interfaces.

In addition to these results with direct impact in the market and for the patients, the project produced a large number of specialised publications, organised five successful workshops, and provided training to 11 fellows, three of whom will obtain their PhD degree within the year to come.

★ Have you tested your two devices on patients yet?

Yes, the project was characterised by a strong clinical validation. For this reason, a clinical partner, the Hospital San Camillo of Venice, was included in the consortium. Thanks to this partner, clinical trials could be performed for all the systems developed during the project.

★ What has been the feedback from potentially interested market players so far?

As already mentioned Tyromotion has recently commercialised a new robotic device equipped with myocontrol. Other than that, Otto Bock HealthCare, industry leader in neurotechnologies, was also part of the consortium and has expressed interest in common patents and in the product development of a new sensory feedback system based on MYOSENS results.

★ The project ended in March. Are you planning to keep building on its results?

The final goals have all been reached but the consortium is unanimously strongly interested in extending the work within the framework of a second EU-funded project.

MYOSENS

★ Coordinated by the University of Gottingen in Germany.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/101648
★ Project website: http://myosens.bccn.uni-goettingen.de

INTERVIEW

NOVEL ELECTRODE SYSTEMS UNVEIL THE MECHANISMS BEHIND HUMAN MOVEMENT

For researchers in the fields of robotics and prosthetics, replicating the subtle combination of mechanisms underlying our movements is both an exciting and a difficult challenge. Scientific efforts under the DEMOVE project have resulted in new electrode systems that are able to do just that.

As simple as it seems, the fact of moving our arm and hand to seize an object is the result of complex events taking place in our brain, spinal cord, nerves and muscles. These so-called discrete events include ion exchanges across membranes, electrochemical mechanisms and active ion pumping through energy expenditure that together form spike trains — the language in which the external world is encoded into our brains.

Recording and interpreting this 'neural code' of movements was at the heart of the EU-backed DEMOVE (Decoding the Neural Code of Human Movements for a New Generation of Man-Machine Interfaces) project. While previous scientific efforts were faced with the impossibility of detecting and processing the activity of motor neurons and the neural code in intact humans, Prof. Dario Farina and his team from the University of Gottingen developed novel electrode systems to fill this gap.

These new systems provide *in vivo* electrophysiological recordings from nerves and muscles in humans as well as

new computational methods and models for extracting functionally significant information on human movement. They help answer open questions in movement neuroscience, build a bridge between the neural and functional understanding of movement, and are hoped to enable new forms of man-machine interaction.

★ How do you explain the current lack of solutions to monitor movement-related neuronal activity in intact humans?

Prof. Dario Farina: Accessing neurons in the central nervous system implies inserting electrodes into the human body and penetrating neural structures (e.g. the motor cortex) with the risk of damage. The surgical procedures for these interventions are complex and risky. Moreover, non-invasive techniques (e.g. MRI, MEG or EEG) lack the required selectivity to decode the complexity of the neural activity during movements.

★ How do your electrode systems allow you to overcome these problems?

We record activity from muscles using muscle tissue as a biological amplifier of nerve activity. Indeed, when nerves connect to muscles, their neural activity is preserved and can be decoded from the electrical activity of the corresponding muscle. This means that although we record from the periphery of the system (from muscles), we are able to identify the output from the spinal cord circuitries whose activity determines the movement.

★ What can you tell us about the results of your project so far?

The project will finish at the end of June this year. It has produced outstanding results in all analysed disciplines. For example, the recording systems we developed allowed us to re-analyse critically the hypotheses made approximately 80 years ago on motor neuron control during movement.

The new recording systems provide the possibility to decode the activity of large populations of motor neurons and separate the information of the central nervous system from the peripheral mechanisms. Results also advanced the field of neuro-mechanics by revealing the mechanical forces produced by neural structures, as well as the field of man-machine interfacing by providing intuitive and robust methods to control myoelectric prostheses.

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

The project is high risk, high gain, and therefore we have faced many challenges. Nonetheless, all of these challenges have been addressed with team spirit and none has resulted in major hurdles. Examples of such challenges included the need to record activity from a large number of muscles simultaneously, the concurrent decoding of large motor neuron populations *in vivo* and the use of these techniques to control myoelectric prostheses.

★ The main potential outcome of your research lies in man-machine interaction. Could you provide examples?

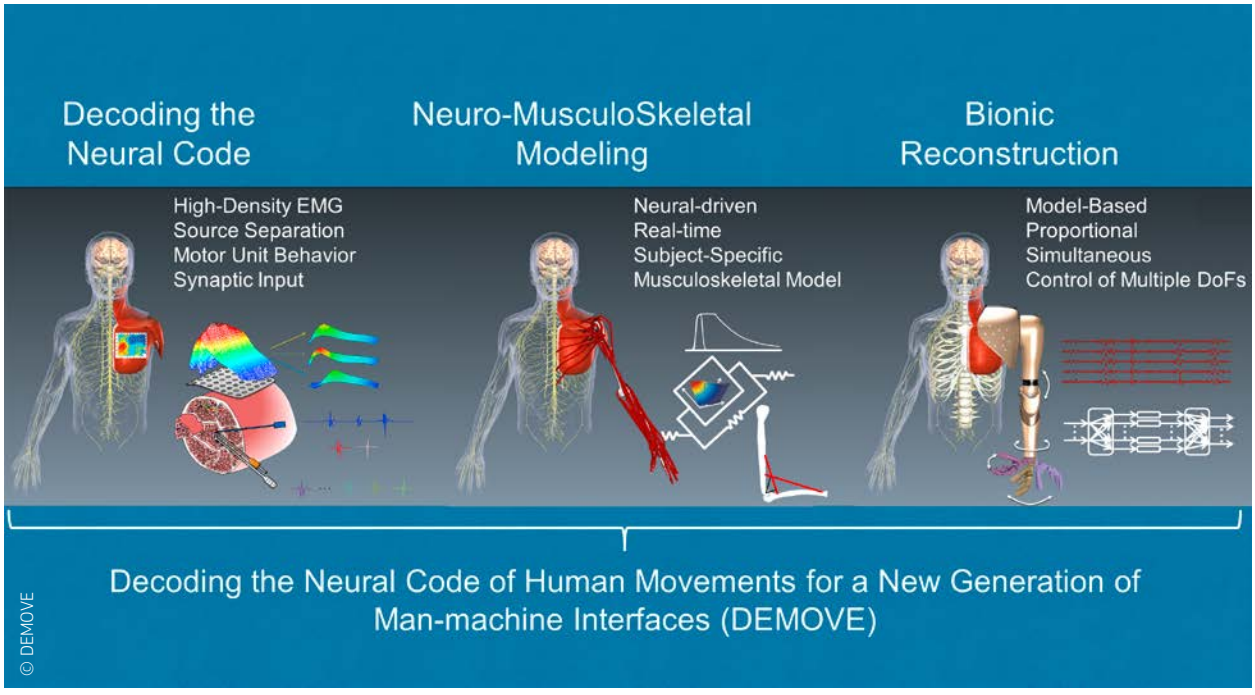
We have proposed and proved the feasibility in this project of upper limb prosthetics fully controlled by the activity of dozens of motor neurons, whose behaviour has been decoded from muscle recordings, also thanks to advanced surgical procedures.

★ With only a few months to go before the end of the project, what do you still want to achieve before and after its end?

Promoting the motor neuron control in man-machine interfacing as a means of extremely accurate and clinically viable control will be our main focus.

DEMOVE

★ Coordinated by the University of Gottingen in Germany.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/project/rcn/99544



USING AVATARS AND ROBOTS TO TREAT SOCIAL DISORDERS

EU researchers are demonstrating how avatars and robots can be used to help patients suffering from schizophrenia, autism and other social phobias.

Schizophrenia, autism and other social disorders cause much suffering for both patients and their loved ones. To address this, the EU-funded ALTEREGO (Enhancing Social Interaction with an AlterEgo Artificial Agent) project has developed a new clinical method, computer architecture and software to help patients adapt their behaviour by interacting with avatars and robots.

"The researchers are expanding the pool of schizophrenic patients to 100 to monitor longer-term evolution in interacting with the avatars."

The ALTEREGO project has brought together many different kinds of professionals: doctors, psychologists, psychiatrists, computer and human movement specialists, as well as mathematicians and roboticists. It is rooted in the innovative rehabilitation of social disorders through the concept of similarity, a new cross-disciplinary theory combining movement neuroscience and cognitive science.

Avatar-led simulations

The similarity theory suggests that it is easier to interact socially with someone who looks like us. This resemblance can be morphological (the form of a person), behavioural (their actions) or kinematic (the way they move). In ALTEREGO, artificial agents such as avatars and robots have been used to manipulate these three components in real-time interaction situations with patients.

The researchers worked with around 40 patients in the first stage of this three-and-a-half-year project, recording their movements with cameras and creating their avatars in computers using virtual reality techniques. Using a 'mirror' game, involving the synchronised handling of coloured balls, which is known to increase affiliation, the patient took it in turns with the avatar to lead, as different variables were introduced in both the game and the movement of the avatar.

'Everyone moves in a very personal way and, using variables, we work with this to transform similarity into difference, by morphing the avatar and trying in this way to change the behaviour of the patient over time,' said project coordinator Professor Benoît Bardy, Director of the European Centre for Research on Human Movement (EuroMov) at the University of Montpellier, France.

Working with iCub

The patients have also been working with iCub, a humanoid robot developed as part of another EU project, ROBOTCUB. It has 53 motors that move the head, arms, hands, waist and legs, and it can see, hear and smile. 'The robot is different. It's not like the patient, so we could also test for the interaction with someone completely different.'

ALTEREGO, which aims to open the door to a new generation of social artificial agents in service robotics, includes research in fundamental and clinical neurosciences, interaction modelling, the development of

new computer-vision techniques and human-robot interfaces, as well as evaluation of the scenarios with patients before, during and after training sessions.

'We appreciate that this is a very sensitive project where the welfare of the patients comes first, so we are careful to continue to seek clearance for all our activities from national ethics bodies,' said Professor Ludovic Marin, the project's lead scientist.

Next steps

In the final six months of the project, the researchers are expanding the pool of schizophrenic patients to 100 to monitor longer-term evolution in interacting with the avatars. They are also developing software to be downloaded by other projects and hope, in future projects, to test the technology on autism and other social phobia patients.

'We also believe it is possible to develop applications that patients can use on screens in the home, perhaps in a TV or home entertainment system, where they perform various exercises with their avatar that can teach them social skills over a longer period of time,' added Professor Bardy.

The ALTEREGO project started in February 2013 and runs until 31 July 2016. It involves six partners in four European countries, and has received EUR 2.9 million in EU funding support.

ALTEREGO

- Coordinated by the University of Montpellier in France.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/124883
- Project website: http://www.euromov.eu/alterego/homepage
- http://bit.ly/1QSs7N3

REAL LIFE MEETS SCI-FI: THE EMBODIMENT STATION

Remember the movies Avatar and Surrogates and their mind-blowing take on what could one day bridge the gap between 'virtual reality' (VR) and 'real' reality? An EU-funded project has moved towards this vision of the future by developing an 'Embodiment Station' through which people can be moved in a virtual or robotic body.

PROF. MEL SLATER

VERE (Virtual Embodiment and Robotic Re-Embodiment) was initiated in 2010 to build upon the rubber hand illusion and, more specifically, what it taught scientists 15 years ago regarding how the brain represents the body, and the plasticity of this representation. In this experiment, psychologists at the University of Pennsylvania had discovered that they could convince people that a rubber hand was their own by putting it on a table in front of them while stroking it in the same way as their real hand.

The VERE project took this finding to the next level by trying to apply it to the whole body. Using novel sensory channels and incorporating both virtual reality and robotics, the team found that it is possible to provide people with an illusion of ownership over a body in virtual reality or an actual robotic body that behaves in correspondence and synchrony with their own movements.

'In immersive virtual reality, a virtual body can substitute your real body. You see the virtual body when you look towards yourself, and in a virtual mirror, it is life-sized and it moves with your movements. It is possible to organise it so that when you see something touch your virtual body, you also feel it on your real body,' explains Prof. Mel Slater, ICREA Research Professor at the University of Barcelona and coordinator of VERE.

This is precisely the level of immersion that Prof. Slater and his team managed to reach with their 'Embodiment Station' directly inspired by the one featured in Surrogates. The station reads electrical brain signals and other physiological signals from participants, but it also transmits the visual, auditory and

tactile inputs from the surrogate body while providing the real body with corresponding muscle stimulation.

The Embodiment Station features a seat integrating different modules that provide specific sensory feedback and decode the participant's motor intentions at the brain level by decoding EEG brain signals. It has already been proved to work even over large distances: for a participant in Israel who was successfully embodied in a robot in France, and for spinal cord injury patients in Italy who were embodied in a robot in Japan.

Advancing state-of-the-art on all fronts

As seen in Avatar, the project team focused part of their work on patients with disabilities, and more specifically those suffering from spinal cord injury. Since these patients lack the multisensory integration process, which is fundamental for bodily representation due to a massive sensorimotor deprivation below the lesion level, this research proved extremely useful in revealing the brain mechanisms of embodiment. Project results notably showed that even though these patients tend to have a reduced ability to embody an external object, boosting residual sensory information may still trigger embodiment.

The latter is just one in many embodiment scenarios studied by the project partners, most of which are expected to lead to concrete advances in domains as varied as the rehabilitation of offenders, robotic embodiment for disabled people and gender-based domestic violence. 'There are several variations of applications that enhance empathy, but much of this is now commercial-in-confidence,' Prof. Slater reveals.

The most notable VERE contributions include findings on how multisensory signals may elicit optimal embodiment sensations for the remote control of virtual or robot surrogates, which have a profound impact on the future design of brain-computer interface systems. The team also showed that vestibular inputs can enhance bodily self-awareness, potentially providing a new lever for virtual reality and neuroprosthetics.

The project results open the way to virtual reality manipulations of body representation as a potential analgesic therapy. The consortium generated an 'Atlas' of the neuro-feedback sensitive brain areas, established the importance of both agent-form and motion-kinematics in the implementation of virtual scenes, and demonstrated that BOLD-fMRI can be effectively utilised in driving a robot and avatar in real time.

The team demonstrated that amputees can navigate an avatar even while using the amputated arm representation. They also showed that virtual embodiment in a body that was considered as 'out-group' could lead to a reduction in racial bias.

The ethics of VR technologies

Another very important contribution of the project resides in its article 'Real Virtuality: A Code of Ethical Conduct.' As novel VR technologies such as Microsoft's Hololens and Facebook's Oculus prepare to enter the market, the project team looked into some of the risks that may arise with the commercial and research use of VR. 'We are introducing a whole new technology so we need to understand its implications,' points out Dr Slater.

The document provides a first set of ethical recommendations to be built upon and notes areas in which further ethical deliberation will be needed. With regards to the risks posed to individuals and society, it extensively covers questions surrounding privacy, red lines for VR and the neglect of real bodies and environments. The effects of long-term immersion are also extensively covered in the paper. The other two parts are dedicated to ethical research aspects and questions related to plasticity in the human mind.

As the paper concludes, 'what is historically new, and what creates not only novel psychological risks but also entirely new ethical and legal dimensions, is that one VR gets ever more deeply embedded into another VR: the conscious mind of human beings, which has evolved under very specific conditions and over millions of years, now gets causally coupled and informationally woven into technical systems for representing possible realities.'

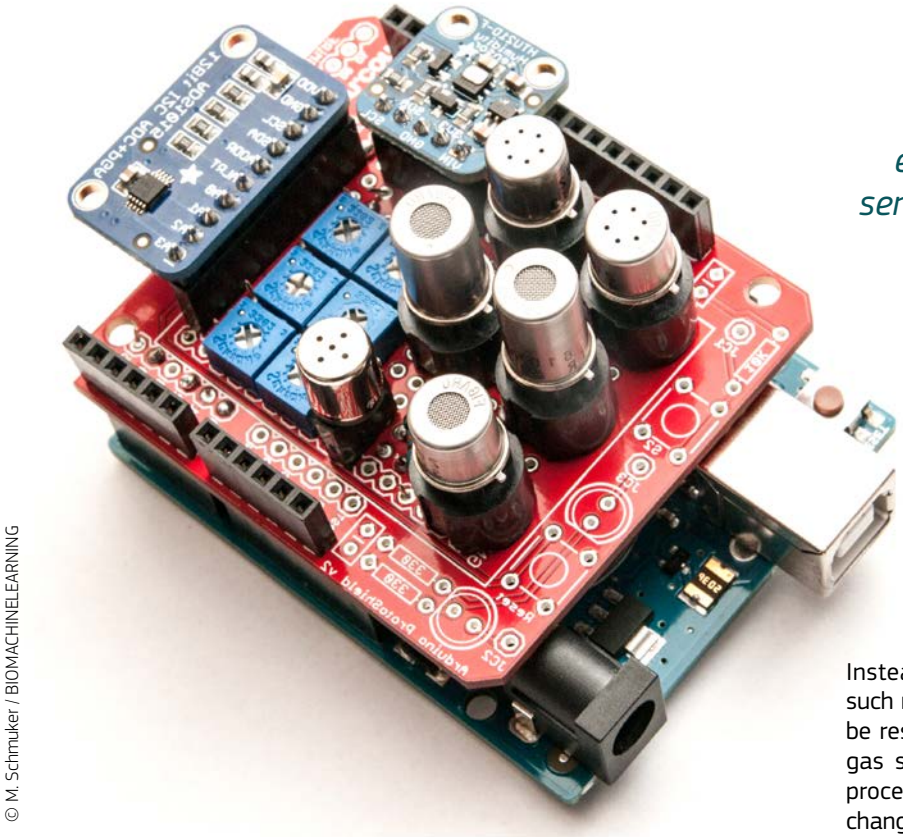
Until this world of a whole new kind emerges, the consortium intends to keep building on VERE results. 'We are currently looking into the funding aspects of creating a spin-off,' says Dr Slater. 'However there are some commercial aspects involved and we cannot talk about the products yet.'

VERE

★ Coordinated by the University of Barcelona in Spain.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/project/rcn/94730
★ Project website: http://www.vereproject.eu

BIG STEPS TOWARDS THE CREATION OF A FULLY FUNCTIONAL ROBOTIC NOSE

An EU-funded project has developed odour recognition and classification systems that open the door to the development of many innovative new applications, including the possibility of real robotic noses.



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"The project's method of enhancing the signal of gas sensors is inspired by the way neurons work."

The BIOMACHINELEARNING (Bio-inspired Machine Learning for Chemical Sensing) project has created a neuromorphic network for odour recognition, running on actual neuromorphic hardware that will be able to receive real-time input from electrical gas sensors.

This is an important step towards the creation of a cost-effective, portable and fully functional robotic nose that could be utilised in a number of different sectors, from agriculture (e.g. monitoring fruit ripeness) and medicine (e.g. diagnosing various diseases) through to personal lifestyle (e.g. finding out the name of a particular perfume smelled randomly during the morning commute).

An unexpected discovery

One of the key challenges in being able to develop this technology is to improve the accuracy and speed of odour detection and identification in electronic nose systems. When investigating how to do this through an analysis of data from electronic gas sensors, the project team made an unexpected discovery. Using bio-inspired signal processing, they were able to enhance the signals from the sensors to a level high enough to resolve variations in gas concentrations that are due to a phenomenon called 'turbulence'.

'Turbulence is a ubiquitous phenomenon in gas sensing, and there's actually quite a lot of information encoded in turbulence-induced variations of gas concentration,' explained principal researcher Dr Michael Schmuker. 'For example, if we're close to a gas source, these turbulence-induced changes occur on very rapid timescales. Further away, the changes are less drastic and much slower. This is a well-established fact that has been known for decades, but it was commonly assumed that sophisticated, fast sensors are required to resolve these small differences.'

Instead, the team discovered that such rapid concentration changes can be resolved with cheap, off-the-shelf gas sensors and appropriate signal processing. 'This was indeed a game changer that paves the way for some very interesting applications,' commented Dr Schmuker.

A bio-inspired solution for odour detection and classification

Armed with this new knowledge, Dr Schmuker and his colleagues have worked towards realising a bio-inspired solution for fast and accurate odour detection and classification.

The project's method of enhancing the signal of gas sensors is inspired by the way neurons work. Neurons respond most to rapid changes in their synaptic input, meaning they can adapt easily. 'The signal processing method we devised operates pretty much like an adapting neuron,' Dr Schmuker said.

Neurons exchange their information through short pulses of activity called 'spikes', which is potentially a lot more efficient than continuously exchanging numbers, as a conventional computer would do. The project is using specialised neuromorphic hardware

(silicon chips that harbour hundreds or thousands of electronic neurons) to accelerate spiking computation and model brain circuits in a very detailed fashion whilst maintaining computational efficiency.

The odour classification network is closely in line with how insect brains mediate the sense of smell. The input data (sensor readings) are encoded by 'virtual olfactory receptors' and then processed by a network that is closely modelled on a component of the insect olfactory system, the antennal lobe. This is crucial for obtaining good odour recognition performance.

Neuromorphic hardware systems

The project used two neuromorphic hardware systems that are fully operational. Odour recognition networks have been successfully deployed on both platforms.

'The efficiency of these systems lies in their massively parallel architecture,' stated Dr Schmuker. 'With the right network, these systems have the potential to perform as well as conventional computers in pattern recognition, but at a fraction of the energy costs.' He also pointed out that many major global tech companies are starting to adopt this technology, indicating that neuromorphic computing is becoming an integral part of the industrial computing infrastructure.

Next steps

The project team are now keen to develop a physical implementation of an electronic nose coupled with neuromorphic hardware, performing odour recognition and/or gas-based navigation on a robot. 'I think such proof-of-concept prototypes are the first step to attract potential industrial partners who may be interested in integrating our results in their product line,' commented Dr Schmuker.

Looking to the long-term, Dr Schmuker also outlined his overall vision for the technology: 'My vision is that electronic noses will be as common as cameras and microphones... Electronic nose technology that has low power requirements and good recognition performance opens the way towards a whole new understanding of our chemical environment.'

BIOMACHINELEARNING

- Coordinated by the University of Sussex in the United Kingdom.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/news/rcn/124865

TRAINING EUROPE'S NEXT GENERATION OF NEURAL ENGINEERS

An EU-funded project has provided young neural engineers with the skills to develop the next generation of brain inspired technologies, ranging from robotic aids to speech processing.

Neural engineering is a new discipline that combines engineering, mathematics, physics and neuroscience to develop brain-computer interfaces, cognitive computers and neural prosthetics. As an emerging field, most scientists pursuing related topics have strengths in one or two areas, but have not received broad multidisciplinary training, as it is relatively hard to come by.

The central aim of the NETT (Neural Engineering Transformative Technologies) project has therefore been to expose early career researchers to different opportunities in both academia and industry, in part by providing input from experienced visiting researchers and corporate research teams. The research fellows supported with NETT funding have successfully generated transformative technologies related to speech recognition, robots with cognitive and social skills, and brain-computer interfaces.

"The implementation of a new neural mass model could have applications in the treatment of neurological disorders, and in particular epilepsy."

'The advances achieved so far could lead to the development of new healthcare technologies, new diagnostic tools and new software applications for neurological researchers,' says project coordinator Stephen Coombes, Professor of Applied Mathematics at the University of Nottingham, UK. 'We could imagine that in the near future, this research could lead to the development of brain-controlled


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prosthetics, robotic assistants, thought-controlled computers and speech recognisers.'

For example, researchers have achieved a better understanding of the effect of transmission delays in the communication between certain brain areas, which could have implications in the treatment of neurological diseases. Novel algorithms for multi-photon scanning of neural tissue could also lead to better diagnostic tools.

'The implementation of a new neural mass model could have applications in the treatment of neurological disorders, and in particular epilepsy,' says Coombes. 'Advances have also been made in detecting the intention to walk in stroke patients; this could have implications for rehabilitation therapies.'

Other breakthroughs include the development of a synchronous dual-arm movement planner for a humanoid robot and the open source platform SPIKY, which will enable researchers to monitor synchronisation in the firing of neurons. Many of these and other innovations have appeared in papers and peer-reviewed journals.

Some seven full partners and 11 associated partners, including large and small companies, joined forces to conduct the structured, industry-focused training and mentorship through internships and secondments addressing real-world problems. 'We have sought to increase the employability of fellows working on this project via internships with industry partners, and through a dedicated training programme in business, academic and social skills,' explains Coombes. 'We've also tried to demonstrate the interrelatedness of various project areas throughout the consortium, and tried to appeal to the wider scientific community and indeed the general public through regular study groups, workshops and public lectures.'

By combining the expertise and infrastructure of a multidisciplinary training network in neural engineering, the NETT project aims to foster a sustainable high level of innovation, and consolidate Europe's position as a leader in an emerging industrial field. The NETT project is due for completion in August 2016.

NETT

- ★ Coordinated by the University of Nottingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/news/rcn/124879
- ★ Project website: http://www.neural-engineering.eu/

MAPPING THE BRAIN'S CORTICAL COLUMNS TO DEVELOP INNOVATIVE BRAIN-COMPUTER INTERFACES

The EU-funded COLUMNARCODECRACKING project has successfully used ultra-high fMRI scanners to map cortical columns, a process that opens the door to exciting new applications, such as brain-computer interfaces.

Cortical columnar-level fMRI has already contributed and will further contribute to a deeper understanding of how the brain and mind work by zooming into the fine-grained functional organisation within specialised brain areas.

"The project team is testing whether it is possible to build high-resolution BCIs at 7 Tesla that allow subjects to write letters of the alphabet simply by imagining how the letters look."

By focussing on this, the project has stimulated a new research line of 'mesoscopic' brain imaging that is gaining increasing momentum in the field of human cognitive and computational neuroscience. This new field complements conventional macroscopic brain imaging that measures activity in brain areas and large-scale networks.

Measuring cortical columns

Cortical columns are a group of neurons in the brain that run from the top to the bottom of the cortex and respond to the same stimulus property. For example, primary visual cortex columns extract small bars with a specific orientation, which are elementary features for analysing the shape of objects.

A single cortical column contains thousands or even tens of thousands of neurons corresponding to a few dozen micrometres and up to 1-2 millimetres for larger aggregated columnar structures.

'It has been extremely difficult though to reliably measure cortical columns with non-invasive functional brain imaging in humans, but COLUMNARCODECRACKING (Cracking the columnar-level code in the visual hierarchy: Ultra high-field functional MRI, neuro-cognitive modelling and high-resolution brain-computer interfaces) has made substantial advances in this,' Professor Dr Goebel explained. 'We've pushed the limits of technology and have developed new paradigms, analysis methods and modelling tools... We've achieved a sub-millimetre range of spatial resolution that allows us to "see" larger columns but we still need to increase resolution further to capture more fine-grained columnar organisations.' After using 7 Tesla MRI, the project has started to do this with one of the few 9.4 Tesla scanners in the world.

Powerful brain-computer interfaces

One of the most promising applications that could result from the project's research is the creation of novel, powerful 'Brain-computer interfaces' (BCIs), using 'Ultra-high field' (UHF) fMRI measurements. 'On the one hand, this provides a challenging test bed for

our newly acquired knowledge about coding principles in brain areas. On the other hand this research could lead to novel applications for some patients, such as those suffering from locked-in syndrome, despite the limited availability of UHF scanners,' said Professor Dr Goebel.

The project has conducted several 7 Tesla fMRI studies to test whether it is possible to create BCIs that exploit information regarding columnar-level features. 'This is extremely challenging because we do not focus on brain activity from external stimulation, instead we investigate brain activity patterns as a result of a participant's imagination, i.e. from self-stimulated brain activity,' explained Professor Dr Goebel. 'We have asked participants to imagine a field of dots moving in different directions. With 7 Tesla fMRI, we could then indeed decode from the generated brain activity in the visual cortex which direction of motion a subject has imagined without showing any external visual stimulus.'

This is exciting, as it indicates for the first time that feature-level information (in this example, different directions of imagined motion) can indeed be used to build fMRI-based UHF BCIs. However, Professor Dr Goebel acknowledges that some improvements are required in order to increase the decoding accuracy before the system can be tested on actual patients.

In one current study, the project team is testing whether it is possible to build high-resolution BCIs at 7 Tesla that allow subjects to write letters of the alphabet simply by imagining how the letters look. This is challenging, as it requires disentangling brain activity that largely overlaps in the same early visual brain areas. The first results with four different letters are promising, but it is not yet clear whether this direct letter imagery BCI will reach high levels of accuracy when using all letters of the alphabet.

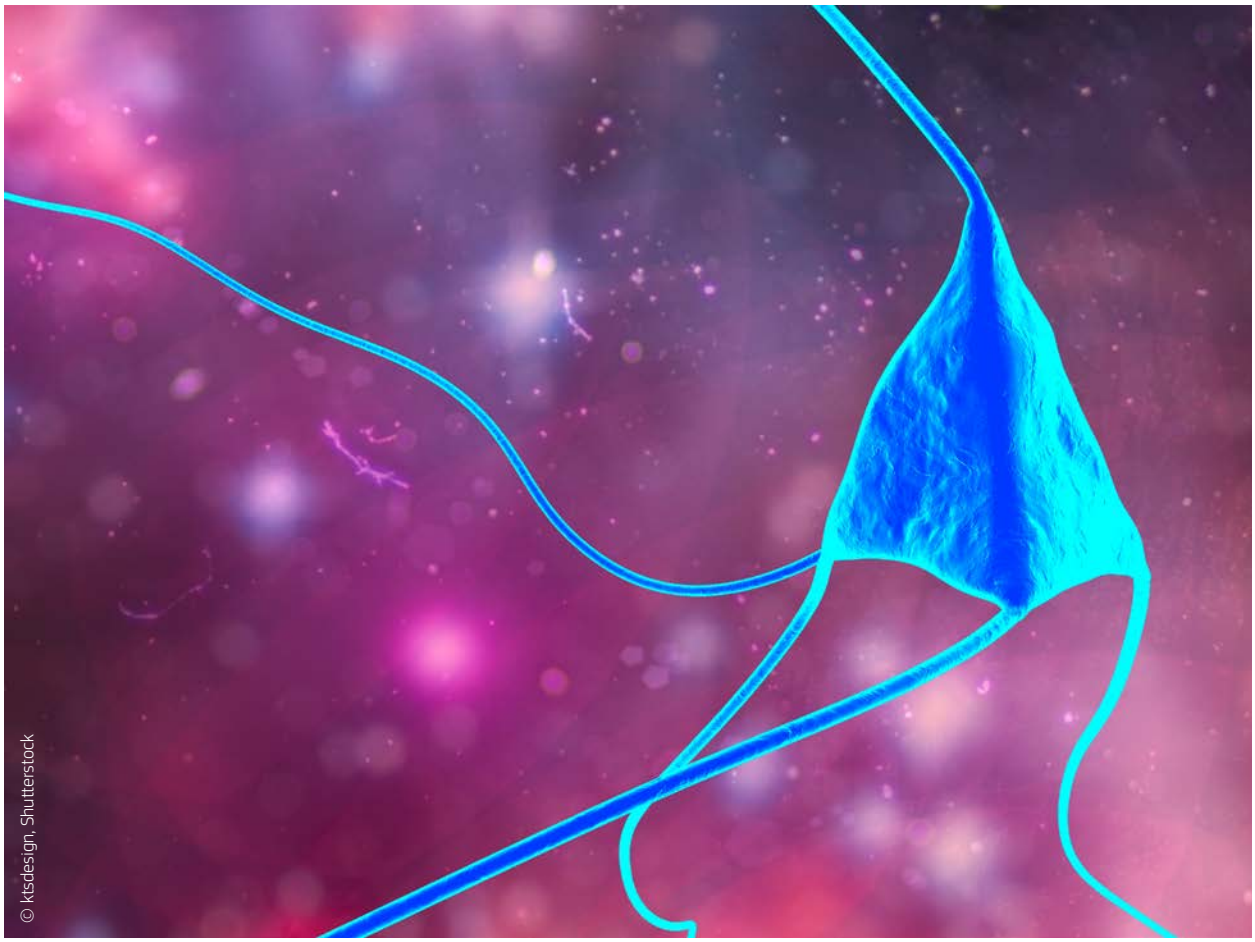
Future research efforts

Whilst the project has produced exciting results, Professor Dr Goebel emphasises that there is still much research to be undertaken. And while the project has mapped the columnar organisation in a few specialised brain areas, there are at least 30 mid-level visual, auditory, somatosensory and multisensory areas where the detailed columnar-level feature representations remain unknown. One example of this is the currently unknown features used by the visual word form area, a region that is active during reading.

'I hope that my current and future research will lead to a deeper understanding of how visual perception and cognition emerge from feature representations and their interactions in the brain,' Professor Dr Goebel stated. Such a deeper understanding could indeed pave the way towards highly advanced BCIs that could not only help treat neurological disorders but also significantly upgrade humankind's ability to integrate and connect organically with high-powered computer systems.

COLUMNARCODECRACKING

- ★ Coordinated by Maastricht University in the Netherlands.
- ★ Funded under FP7-IDEAS-ERC.
- ★ http://cordis.europa.eu/news/rcn/124885



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MAJOR SCIENTIFIC BREAKTHROUGH WITH THE CREATION OF THE FIRST BIOLOGICAL SUPERCOMPUTER

Researchers from the EU-funded ABACUS project have created a model biological supercomputer that is both sustainable and highly energy efficient.

The ABACUS (Parallel computing based on designed networks explored by self-propelled, biological agents) model bio-supercomputer is powered by 'adenosine triphosphate' (ATP), the substance that provides energy to all of the cells in a human body. The model is able to process information extremely quickly and accurately using parallel networks, in the same fashion that electronic supercomputers are able to process information.

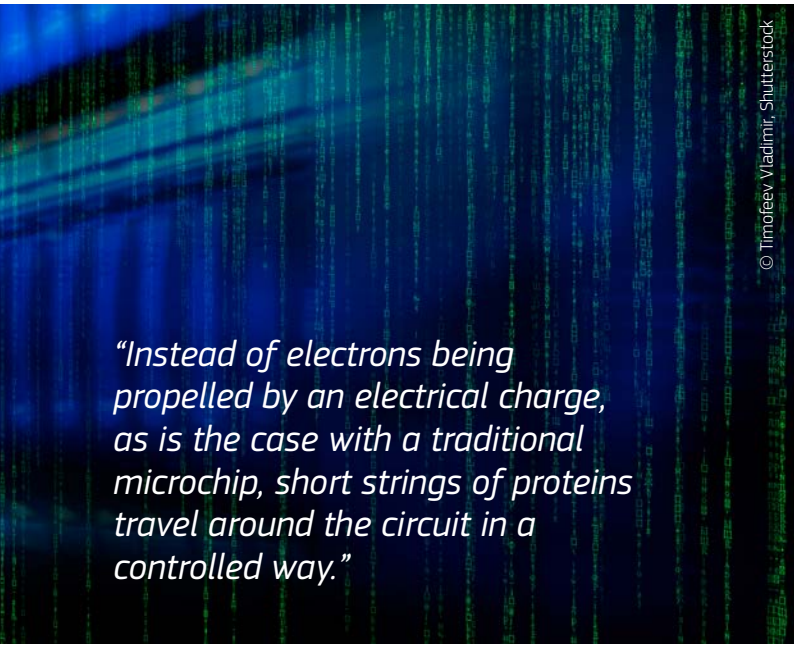
However, the bio-supercomputer developed by the project team is much smaller and more energy efficient than the current generation of electronic supercomputers, being only the size of a standard-sized book.

The model bio-supercomputer was created with a combination of geometrical modelling and engineering expertise on the nano-scale. Importantly, it is the first step in showing that a biological supercomputer could realistically work in practice.

Small, portable and energy efficient

The circuit created by the researchers is around 1.5 cm square, and instead of electrons being propelled by an electrical charge, as is the case with a traditional microchip, short strings of proteins (called 'biological agents' by the project team) travel around the circuit in a controlled way. These movements are powered by ATP, a biochemical that enables internal energy transfer among cells.

Traditional supercomputers use a large amount of electricity and therefore heat up to such high temperatures that they need to be physically cooled in order to function effectively. To do this, many supercomputers often require their own dedicated power plant.



In contrast, due to being run by biological agents, the bio-supercomputer hardly heats up at all and is consequently much more sustainable and cost-effective. As the technology is developed further over the coming years and possible routes to larger-scale commercialisation are considered, this could become a major selling point.

Calculating answers to major societal issues

Although the model bio-supercomputer has successfully and efficiently tackled a complex mathematical problem by using parallel computing in the same fashion as traditional supercomputers, the project team recognises that there is still a long way to go between the model and the development of a full-scale functional bio-supercomputer.

It is hoped that an eventual shift to bio-supercomputers will provide solutions to the growing problem of traditional supercomputers being increasingly unable to quickly calculate answers to some of society's most pressing issues, such as the development of new drugs and ensuring that engineering systems work as they are supposed to. For these problems, computers have to simply go through all of the possible guesses before reaching the correct answer. This means that if the problem size increases even modestly, the computer can no longer solve it quickly enough to be useful.

Next steps: From science fiction to science

The project team has already begun to explore other avenues on how to push their research even further, and hopes that other scientists will also be encouraged to construct new models using alternative biological materials.

The ultimate goal would be to perfect the design for a new generation of smaller, more portable and more energy-efficient bio-supercomputers that can fully replace traditional supercomputers.

Although the research team believes that it will still take some time for this to become a reality, a potential mid-term solution would be to produce a hybrid design, mixing traditional and biological technologies.

The ABACUS project, which received over EUR 1 725 000 of EU funding, is coordinated by Lund University in Sweden, but the research that led to the creation of the model was spearheaded by a team at McGill University in Montreal, Canada, one of the ABACUS consortium members.

ABACUS

- Coordinated by Lund University in Sweden.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/124861
- Project website: http://abacus4eu.com/

BIOLOGY AND MEDICINE

EPIGENETIC ALTERATIONS KEY FOR DETECTING AND PREVENTING BREAST CANCER

EU-funded researchers have uncovered how genetic changes can increase the risk of a woman contracting breast cancer, paving the way for the development of new screening techniques and preventative strategies.

The EPI-FEM-CARE (Epigenetics for Female Personalised Cancer Care) project has published research results showing that DNA changes are already present in healthy tissue of women with breast cancer.

The project — which aims to develop new methods for screening, diagnosing and personalising treatment of breast and ovarian cancer — undertook the research in order to decode how breast cancer, the most common cancer to afflict women, develops.

Every year, 330 000 women in the EU are diagnosed with breast cancer and 90 000 will die from the illness.

Epigenetic changes and key risk factors

Previous research has shown how there are key risk factors associated with an increased risk of cancer development. These include family history, early menstruation and menopause starting late.

These risk-mediating factors slightly alter the genetic programme inherent in breast cells at the time of exposure to the risk.

These alterations are memorised by the cells over several decades, a process involving the epigenome which controls the accessibility of the DNA sequence and consequently influences the interpretation of the genome and the fate of the affected cell.

EPI-FEM-CARE researchers analysed a total of 668 breast tissue samples, including both breast cancer samples and samples from women who did not have cancer. This was carried out through a unique statistical approach developed by the project.

The most striking discovery from this analysis was that normal tissue adjacent to breast cancer is characterised by tens of thousands of epigenetic alterations.

Importantly, a large component of the detected variable epigenetic signature was enriched in the corresponding breast cancer tissue, supporting the researchers' hypothesis that this variable epigenetic signature marks susceptible precursor cells crucially involved in breast cancer development.

Additionally, the results highlight that cases of breast cancer which were exhibiting epigenetic changes were associated with a significantly poorer prognosis and a decreased chance of survival from the disease.

Developing new interventions and prevention strategies

The project team argues that the application of these altered epigenetic signatures holds the key to designing new interventions and preventive strategies that could effectively 'deactivate' this epigenetic defect.

Most important, the new data indicates how epigenetic alterations, if detected early enough, could be used to screen and identify women at a higher risk of developing breast cancer before the illness has the chance to fully develop.

Overall, the results also highlight the importance of interdisciplinary work and cooperation, with the project combining clinical, biological and statistical expertise in order to obtain its results.

EPI-FEM-CARE

- ★ Coordinated by University College London in the United Kingdom.
- ★ Funded under FP7-HEALTH.
- ★ http://cordis.europa.eu/news/rcn/124781
- ★ Project website: http://www.epifemcare.eu/default.htm
- ★ http://bit.ly/1YvVPJb

SEX DETERMINATION GENES OF THE MOSQUITO

Only the female mosquito is able to carry and transmit the malaria parasite as her diet requires blood for the nutritional requirements when producing young. The male however feeds on nectar, so research is looking at this diversity in mosquito sex development genes for clues to combat this disease.

The EU-funded VECTRAP (Sex determination pathway in the malaria vector *Anopheles gambiae*) project has looked at the genes activated in male and female *A. gambiae* mosquitoes during development and sex differentiation. Using high-throughput sequencing, bioinformatics, molecular biology and mosquito genetic manipulation, the research team looked for genes that are differentially transcribed in sex determination.

Overall analysis of the qualifying genes revealed that female-biased genes evolve more rapidly than male ones. Specially designed software analysis identified an important set of sex-specific genes, 'Accessory gland genes' (ACPs). Silencing these genes in the male brought about much-reduced progeny numbers.

Further investigation into the possibly linked ACPs and sex-related traits made use of the 10 *Anopheles* species complex to study the evolution of sex-specific genes. Results showed that genes responsible for a male accessory gland protein are clustered on one chromosome arm in the *A. gambiae* group. However, this is not the case outside this species group.

VECTRAP research has shown that genomic knowledge and manipulation can change mosquito fertility, thereby reducing the population size and extent of the malaria vector. Furthermore, studies into the genetics of sexual differentiation could enable manipulation of the sex ratio and avoid production of the female vector. Generally, insects are formidable agents for microbial diseases in humans as well as crops, and the VECTRAP knowledge base could be extended to control all insect vectors.

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VECTRAP

- Coordinated by the Imperial College of Science, Technology and Medicine in the United Kingdom.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/175216

PLURIPOTENCY — LINK TO CARCINOGENESIS

A European study pursued an interesting approach for studying pluripotency and carcinogenesis. By investigating the developmental pathways of a novel model organism, researchers hoped to unveil the relationship between these two processes.

Pluripotent stem cells can differentiate into many cell types, thereby comprising an attractive cell source for regenerative therapy. So far, transplantation of such cells *in vivo* has been characterised by teratoma (encapsulated tumour) formation and an inability to differentiate to the tissue of interest. To understand why teratomas form, the EU-funded PLURIPOTENCY (A new model for study relationship between pluripotency and tumorigenesis: Molecular insights from basal chordates) project studied the chordate *Botryllus schlosseri*.

"Botryllus schlosseri has proved an ideal model organism for uncovering evolutionarily conserved basic molecular mechanisms that regulate cell fate in a non-embryonic context."

Botryllus schlosseri was chosen as the model organism due to its unique capacity to regenerate its body from pluripotent cells through a teratoma-like intermediate. During vascular budding, abnormal developmental stages occur where pluripotent cells are maintained and eventually regain positional identity and differentiate 'correctly' into a functional body. This latter process is termed blastogenesis.

Project researchers were confident that by studying this chordate they could extract important information that could be extrapolated to human pluripotent stem cells. They analysed gene expression during vascular budding and blastogenesis to identify candidate genes involved in the maintenance of pluripotency and cell differentiation. Researchers successfully provided a complete assembled transcriptome of *Botryllus schlosseri* and elucidated key processes such as vascular budding.

PLURIPOTENCY cloned 30 candidate genes implicated in 'stemness', differentiation or cell fate determination. Scientists also published a newly developed methodology for tracking phagocytic cells *in vivo*. This helped describe their role during regenerative processes.

Botryllus schlosseri has proved an ideal model organism for uncovering evolutionarily conserved basic molecular mechanisms that regulate cell fate in a non-embryonic context. Learning how pluripotent stem cells form a teratoma and differentiate into desired cell types instead of becoming carcinogenic should have several biomedical applications.

PLURIPOTENCY

- Coordinated by CNRS in France.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/91782

INNOVATIVE MATTRESS AIMS TO PREVENT CASES OF SUDDEN INFANT DEATH SYNDROME

EU researchers have developed and are now in the process of patenting an intelligent monitoring system to prevent unexpected deaths in otherwise healthy infants.

The EU-funded project, BABYCARESLEEP (Development of a non-invasive baby sleep monitoring and intelligent control system for the prevention of unexpected death in previously healthy babies and early detection of risky situations), has developed a novel, non-invasive intelligent monitoring system which is able to detect risky situations at an early stage and will help to prevent 'Sudden infant death syndrome' (SIDS). A patent of the prototype system is now being prepared by project partner, Elastic Confort.

Continuous baby monitoring

Integrated into the baby's cot, the specially-designed mattress uses biosensing textiles and matrices of sensors to detect and constantly monitor the baby's most relevant biological parameters, including its breathing rate, temperature, pressure and pH levels.

Sensors detect if the baby stops breathing and if CO_2 levels inside the child increase in parallel to a falling oxygen level.

In the event of such a situation, the specially-designed mattress then vibrates gently, stimulating the baby's brain and prompting it to breathe. This avoids hypoxia but is gentle enough not to wake the baby from its sleep.

To be able to accurately detect a potentially dangerous situation with the infant, the system is equipped with a Risk Assessment and Actuation Algorithm that sets the rules and thresholds against which the baby's biological parameters are measured. The algorithm also determines the level of corrective actions to take, such as the level of vibration applied within the mattress.

In the event that a baby does not react to stimulation following the detection of a potential emergency situation, the BABYCARESLEEP system alerts the parents with alarms and online alerts via both smartphone and computers.

SIDS is the highest cause of death in the post-neonatal period — from the second to the sixth month of life.

In Europe alone, 2 400 infants still die of SIDS annually. The condition is most common in preterm newborns, around 385 000 of which are born each year in Europe. It is an unexpected disease which occurs in infants where there is no evidence of accidental asphyxia, inflicted injury or organic disease.

Next steps for the project

With the patenting process now well underway, it is hoped that full commercialisation will be achieved within four years, achieving cumulative benefits of more than EUR 10 million for the SMEs involved in the project.

Project partners estimate that the BABYCARESLEEP system will reach approximately 31 000 families over the first four years of commercialisation and will lead to an increase in the quality of life for more than 5 million European infants and their families.

BABYCARESLEEP

- ★ Coordinated by Colchones Delax in Spain.
- ★ Funded under FP7-SME.
- ★ http://cordis.europa.eu/news/rcn/124817
- ★ Project website: http://babycaresleep.com/

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HAEMATOPOIETIC STEM CELLS AND MICRORNAS

Somatic stem cells are present in most tissues and contribute to tissue homeostasis by replenishing short-lived cells. Understanding how this occurs is key for regenerative medicine.

'MicroRNAs' (miRNAs) are non-coding RNA molecules that have emerged as key regulators of gene expression. They bind to and inhibit translation of target messenger RNAs. Their role is well established in embryonic stem cells, but little is known about how they regulate translation in adult stem cells.

Adult stem cells must balance between self-renewal and differentiation to avoid exhaustion. As a result, identification of the molecular determinants of this decision could be used to shift the balance for regenerative purposes.

The EU-funded HSC SELF-RENEWAL (Global microRNA profiling of normal and Pbx1-null hematopoietic stem cells and progenitors for the identification of new regulators of the balance between self-renewal and differentiation) project focused on 'Haematopoietic stem cells' (HSCs)

"Scientists found 48 miRNAs differentially expressed between Pbx1-null and normal HSCs, as well as another 70 whose expression altered during the transition from HSC to MPP."

and the role of miRNAs in the maintenance of self-renewal. Previous work had shown that HSCs with a deletion in the proto-oncogene Pbx1 display reduced self-renewal, a high proliferation rate and a premature myeloid differentiation profile.

In the present study, scientists used a Pbx1-conditional knockout mouse model to identify miRNAs involved in the maintenance of HSC self-renewal. For this purpose, they performed global miRNA profiling of HSCs and of their immediate downstream progeny called 'Multi-potent progenitors' (MPPs). The latter lack long-term self-renewal capacity and represent the first maturation step in the haematopoietic hierarchy.

Scientists found 48 miRNAs differentially expressed between Pbx1-null and normal HSCs, as well as another 70 whose expression altered during the transition from HSC to MPP. Of particular interest was one miRNA that displayed an HSC-specific pattern and was deregulated in chronic myeloid leukaemia. The results from *in vivo* loss-of-function or gain-of-function experiments indicate that a tight regulation of the miRNA studied is necessary to maintain HSC function.

Overall, the work carried out by HSC SELF-RENEWAL provides unprecedented evidence of the role of miRNA molecules in normal HSC self-renewal. The finding that the same miRNAs may also be involved in leukaemia opens up new paths for anticancer targeting therapies.

HSC SELF-RENEWAL

- ★ Coordinated by Humanitas Mirasole in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/92294

INTERNATIONAL VIRUS LIBRARY NETWORK

An unprecedented effort has been made to coordinate storage and access to virus collections on a global scale. As part of this, EU funding supported the development of a readily accessible virus archive with an extensive collection using global networking.

The fight against viral infections requires intricate knowledge of viral mechanisms of action, so researchers need access to specific strains. The EVA (European virus archive) project has successfully set up a large network of recognised centres to store viruses safely. An expanding web-based catalogue should help advertise and distribute viruses in the collection as well as associated products.

EVA developed high-quality safety procedures for handling virus collections and ensured quality through best practice guidelines and audits. Their resources are being used to support virus amplification and sustainable long-term storage.

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EVA researchers estimate that more than 10 000 viruses are distributed globally in small laboratory collections. Many of these could be lost to science if they are not brought together in a coordinated, high-quality collection.

The EVA web-based catalogue is functional and user friendly, and provides access to database products that are increasing continuously as the number of contributing laboratories increases. High-quality control standards are maintained when shipping viruses and their derivative products, such as gene segments.

EVA initially aimed to develop its platform at the European level. However, the network has been extended to incorporate all major collections globally. Indeed, EVA has grown from nine initial members to 27 currently, with new partners joining from Europe (Germany, Italy and the Netherlands) and around the world (China, Russia, South Africa and Turkey).

EVA also integrated the World Health Organisation Global Outbreak Alert and Response Network for the control of viral disease in developing countries. They will supply access to highly pathogenic biosafety level-4 viruses for the European Research Infrastructure on Highly Pathogenic Agents. These include Ebola and Lassa fever viruses. EVA also established links with the World Organisation for Animal Health as several veterinary institutions also joined this network.

The EVA network continues to spread with future collaborations foreseen with Australia and the US. The project website highlights the latest news on viral outbreaks, particularly when a virus has emerged in a new geographical location. Laboratories in developing countries can now access high-calibre facilities and contribute to the expanding pool of viruses and reagents. This should help us deal more effectively with the threat of viral infections.

EVA

- ★ Coordinated by the IRD in France.
- ★ Funded under FP7-INFRASTRUCTURES.
- ★ http://cordis.europa.eu/result/rcn/86385
- ★ Project website: http://www.european-virus-archive.com/

SOCIAL SCIENCES AND HUMANITIES

NEW RECOMMENDATIONS FOR REDUCING POVERTY IN EUROPE

An EU-funded project has outlined its key policy recommendations on how European governments can better tackle poverty and improve social cohesion through evidence-based policymaking.

The IMPROVE (Poverty Reduction in Europe: Social policy and innovation) project focussed on policies undertaken by European governments before, during and after the Great Recession of 2008-2009 that have been specifically enacted as a means to reduce poverty and increase social cohesion.

Its key findings were unveiled during the project's final conference in Antwerp, Belgium, from 3-5 February 2016.

Demographic change and employment's impact on poverty

The overall key message from the project is that poverty is not a static phenomenon and that the drivers between poverty entry and exit vary between countries.

One of the key drivers identified was that demographic changes are relatively more important than other factors for tackling poverty, particularly for Northern Europe countries. The rate of poverty entry was more prolific in Southern European economies that have been facing a prolonged demographic crisis of a rapidly ageing population.

Another finding was that employment rises did not strongly reduce poverty before the economic crisis, instead the employment and poverty rates often mirrored each other.

'Overall, a 10% employment rise will be associated with a 2.5% drop in poverty rates, but allowing for country differences and varying patterns over time reduces the effect to 1.9-2.5%,' explained Professor John Hills from the London School of Economics (LSE). 'In short, employment doesn't solve everything.'

However, following the onset of the crisis, there was a much clearer correlation between dropping employment rates and rapidly rising poverty, especially in Central, Eastern and Southern Europe countries.

Effective policies to reduce poverty

In some of the countries worst hit during the crisis, several austerity measures were fair in design, the project concludes. Cuts in public sector pay had progressive effects, particularly in Greece, Portugal and the Baltic states.

Changes in direct taxation and social insurance policies were also generally positive. Pension reduction reforms and other social benefit changes had varying results across countries and closely depended on their structural design.

The project also discovered that increasing the minimum wage did not dramatically decrease poverty levels, as most individuals on the minimum wage were already above the official poverty line.

However, increasing the income tax threshold was even less effective, with the UK and Belgium being used as examples.

On the other hand, increasing child benefit allowance was found to be much more effective in reducing poverty, with the project looking at case studies in Greece, Estonia, Italy and Hungary. The project did note though that this is also a very expensive option and could be much more difficult for poorer EU countries to effectively implement.

Lessons for 2020 and beyond

The project team strongly emphasised that each country has had its own unique experience of reducing poverty, depending on its economic strength and welfare system, as well as its record on effectively implementing public policy.

The 2000s were a 'lost decade' for poverty reduction in Europe, with governments often making changes to social systems that had the opposite of the intended effect.

Overall, the project results argue that the annual monetary adjustment of social benefits and tax thresholds can have a larger impact on poverty reduction than deeper structural reforms. If these thresholds aren't regularly updated to take economic factors into account, such as the rate of inflation, then other policy instruments have to work much harder to have a noticeable impact on reducing poverty.

Speaking at the end of the conference, Stefaan Hermans, the Head of Cabinet for Marianne Thyssen, European Commissioner for Employment, Social Affairs, Skills and Labour Mobility, stated the importance of linking the EU's policy agenda with the research agenda championed by the IMPROVE project.

'It is clear that when we want to make progress on poverty reduction in Europe, we need to have the methodologies, reliable data, a common discourse and a common understanding,' he concluded.

IMPROVE

- Coordinated by the University of Antwerp in Belgium.
- Funded under FP7-SSH.
- http://cordis.europa.eu/news/rcn/124804
- Project website: http://improve-research.eu/

ANCIENT TEXTILE TERMINOLOGY

An interdisciplinary study on ancient textile terminology has shed light on the economy, society and culture of ancient Near Eastern civilisations. This work contributes to a better understanding of the role of textiles in shaping ancient and modern societies.

In ancient times, textiles played an important role in the development of economies and societies. Beyond that, they helped to shape a reality through aesthetic and ideological conceptualisation.

ASTEX (Assyrian textiles: A study on the terminology and the material culture of the textiles in the Neo-Assyrian Empire) was an EU-funded project that researched the use of textile terminology in the first millennium BC. Until now, no studies have been devoted to textiles in the Neo-Assyrian period.

An investigation into the entire terminology of textiles in written documents from archives of the period was one of the main research goals. This involved an analysis of the vocabulary in a broad linguistic context, including a comparison with Old and Middle Assyrian. An evaluation of the continuity of the lexicon was therefore possible.

"The investigation led to a deeper awareness of textile production."

The investigation led to a deeper awareness of textile production. Additionally, the importance of using material culture in uncovering textual data about textiles became evident. A traditional lexicological approach was crossed with a new interdisciplinary perspective combining archaeology, history of technology, tool studies and iconography.

Mid-term results were presented at the second international conference on textile terminology, Textile Terminologies from the Orient to the Mediterranean and Europe 1000 BC – AD 1000. This increased the impact in the field of disciplinary research and provided a venue for sharing ideas on textile terms and techniques. The research was also presented at an outreach seminar aimed at disseminating results to the public. Non-specialists were therefore able to learn about religious representations in Neo-Assyrian political discourse.

Conference articles and book chapters have been published and a manuscript is in progress. Results disseminated via lectures and publications can contribute to continuing the research into the terminology of textiles of the ancient Near East in the first millennium BC. Furthermore, the importance of integrating philological and historical research with material culture studies and ethnography has been exemplified.

ASTEX

- Coordinated by the University of Copenhagen in Denmark.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/175228


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NOVEL ECONOMETRIC MODELS TO MANAGE FINANCIAL CRISES

Europe's debt crisis highlighted the need to step up efforts in monitoring economic conditions and forecasting market trends. An EU initiative has developed tools to aid in the identification, prediction and regulation of European financial markets and economies.

To forecast future developments in the economy, models based on methods such as 'Multiscale spectral analysis' (MSA) offer much potential. With this in mind, the EU-funded ASPECT (Advanced spectral techniques in econometric modelling of macro-financial linkages in the euro area) project developed new forecasting models to shed light on the euro area's macroeconomic and financial issues.

Project partners exploited several cutting-edge econometric techniques employed in identifying multifaceted dynamics of global markets, especially the euro area. Findings were used to examine the effect of long and short-term shocks to EU and global economies. They also looked into the probability of markets through MSA and 'Dynamic stochastic general equilibrium' (DSGE) modelling, another forecasting model.

The team measured national and global mutual reliance on fluctuations in economic activity that an economy experiences between periods of growth or recession in the euro area. It also developed new DSGE and time-varying econometric models and assessed the predictability of DSGE models against established statistical tools in use until today.

To forecast economic and financial markets, ASPECT developed novel multiscale decomposition methods. It also created a spectral timescale non-linear causality testing approach and studied the contagion, decoupling and spillover effects of the American financial crisis on the euro area, Asia, Brazil, China, India, Russia and South Africa.

Researchers uncovered new findings concerning asset forecastability and heterogeneous behaviour in financial markets. In an effort to explain inefficiency and market volatility, they investigated how information is disseminated in global markets. Partners also showed that market interdependencies could be key to optimal asset allocation and portfolio diversification.

ASPECT exploited the field of economics to propose innovative modelling methods. By doing so, it will provide new directions for policymaking and crisis management in the post-financial crisis era.

ASPECT

★ Coordinated by Athens University of Economics and Business — Research Center in Greece.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175168

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EARLY SCANDINAVIAN TRADE

A study on early modern Scandinavian clothing, fashion and textile trade offers a better understanding of how international trade shaped Scandinavian cultures during the Renaissance.

TRADE (Global encounters: Fashion, culture and foreign trade in Scandinavia, 1500-1630) was an EU-funded project that investigated this trade using an array of methods from various disciplines. This included art and cultural history, archaeology, anthropology, economic and social history, and fashion theory. In addition to looking at these changes, it also explored how individuals' lives were transformed as a result.

Visual sources and documents were discovered in historical archives in Finland and Sweden. These included wardrobe inventories, commercial letters, trade records and account books. The research showed that Scandinavia was significantly less isolated than recent scholarship thought. Novelties and new fashion accessories were ordered and imported to Scandinavian towns from diverse geographical areas. Scandinavians were also able to acquire non-European goods that had arrived in Europe through the international ports in Venice, Genoa, Lisbon and Spain.

Results have been disseminated via numerous publications, in academic papers presented at international conferences, and in major institutions in Europe and New York. One important result is the advancement of more comprehensive questions about the interpretation of the value, origins and stylistic variations related to dress and textiles. This led to investigating differences between experimental and experience research. Additionally, the project created a research blog for communication and publishing purposes. This will continue to broaden the spectrum of knowledge for the general public.

"Scandinavia was significantly less isolated than recent scholarship thought."

TRADE

★ Coordinated by the University of Copenhagen in Denmark.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175230

ENERGY AND TRANSPORT

CONSTRUCTING ENERGY-EFFICIENT SCHOOLS FOR THE FUTURE

The EU-funded SCHOOL OF THE FUTURE project has devised innovative solutions and designs that will allow for the creation of a new generation of highly energy-efficient school buildings.

The project aimed to create, demonstrate and publicise the opportunities for constructing high energy performance schools. With four demonstration retrofitted schools throughout Europe located in different climates (Denmark, Germany, Italy and Norway), the project highlights how schools can be exceptionally energy efficient and provide a high-quality indoor environment, whilst being economically feasible.

Enhancing efficiency and cutting energy use

By renovating existing school buildings and their systems, integrating renewable energy solutions and creating advanced management systems, the project aimed to demonstrate that total energy use can be cut by a factor of three.

Moreover, a 75% cut in the energy used for heating can be achieved with an investment of less than EUR 100 per square metre, according to the project. They also create greater awareness of energy-efficient school concepts which will boost the uptake of innovative retrofitting measures and improve the school experience for future generations of children.

SCHOOL OF THE FUTURE (School of the Future – Towards Zero Emission with High Performance Indoor Environment) also demonstrates how retrofitting can enhance the quality of the indoor environment by improving air, daylight, acoustics and thermal comfort for pupils and staff.

The successful introduction of zero emission buildings is the goal of many energy efficiency policy roadmaps up to 2020 across Europe. This project contributes to this ambition by demonstrating cost-efficient measures and showcasing how these can be replicated.

Moreover, the project expects the large-scale deployment of energy-efficient school concepts before 2020, inspired by the four demonstration sites and the guidelines and online resources available.

Disseminating the project results

The project also aims to create a multiplier effect via school pupils who will disseminate the energy-efficient features of their school buildings to their families.

Additionally, it aims to improve perceptions of innovative energy-saving retrofit concepts amongst personnel working for public building administrations. It has also published four retrofit guidelines on indoor environmental quality in schools and on solutions for existing zero emission or energy surplus schools.

The project has created an online building diary for the sites in Germany, Denmark, Italy and Norway, a simple energy performance calculation tool for use in school lectures and three sets of training material for pupils, teachers and technical service personnel.

SCHOOL OF THE FUTURE is also a major contributor to the EU BUILD UP portal, the European information portal for energy efficiency in buildings.

SCHOOL OF THE FUTURE

- Coordinated by Fraunhofer in Germany.
- Funded under FP7-ENERGY.
- http://cordis.europa.eu/news/rcn/124805
- Project website: http://www.school-of-the-future.eu/

NEW TOOLBOX TO HELP BOOST AND SECURE EUROPEAN ELECTRICITY NETWORKS

EU researchers have created an innovative toolbox to ensure the safety and continued security of European electricity networks, and to help facilitate a greater shift towards renewable energy sources.

The EU-funded UMBRELLA (Toolbox for Common Forecasting, Risk assessment, and Operational Optimisation in Grid Security Cooperations of Transmission System Operators (TSOs)) project unveiled its key successes and deliverables during a one-day workshop in Brussels on 26 January 2016. This included the creation of a toolbox prototype for 'Transmission system operators' (TSOs) to guarantee secure grid operations in future electricity networks with a high penetration of intermittent 'Renewable energy sources' (RES).

The toolbox enables TSOs to act in a coordinated European target system where regional strategies converge to ensure the best possible use of the European electricity infrastructure.

"Individual software tools have been extensively tested using IEEE test systems based on the historical datasets of nine TSOs' target area through a decentralised approach."

There is a growing contribution of less predictable and more variable RES, which is taking place alongside the gradual integration of national markets into one common European electrical energy market. Market mechanisms are increasingly not being able to cover certain aspects of system security, leading to high deviations between scheduled and physical flows in terms of time, direction and volume.

As a consequence, meteorological forecasting errors may lead to unforeseen violations of operating limits and trigger cascading outages in stressed-system situations.

This results in the need for more complex operational planning and transmission operation, taking the network closer to its operational limits.

The UMBRELLA toolbox

The UMBRELLA toolbox includes a deterministic and probabilistic optimisation framework for corrective actions to cope with simulated risks on different timescales and increasing system complexity. The overall aim of this is to reduce the total cost of uncertainty whilst also increasing system security and transmission capacity.

Individual software tools have been extensively tested using IEEE test systems based on the historical datasets of nine TSOs' target area through a decentralised approach. They were also applied to historical case studies, such as the European cold snap on 8 February 2012 and the stressed-grid situation that arose on 22 August 2012.

The tests conducted showed that overall the UMBRELLA toolbox is able to calculate remedial actions to ensure the safe and reliable operation of the transmission network, and gives the operator additional information about the range of uncertainty to be expected.

'This gives the operators and operational planners the necessary time to prepare the actual implementation of the proposed remedies,' commented project coordinator Helmut Paeschke.

The UMBRELLA tools are useful for TSOs and offer users the flexibility of applying either individual modules or the complete set of functionalities.

Next steps

Further development of the toolbox and a parallel dry run are currently being prepared. The UMBRELLA toolbox will be embedded in established information systems, and consequently the extension of data exchanges will be crucial. To make the rollout of the toolbox as smooth as possible, the project recommends a stepwise approach for its implementation by TSOs and other relevant stakeholders.

Finally, the project has provided a series of key recommendations to regulators, policy makers and TSOs in fostering the necessary harmonisation of the legal, regulatory and operational framework to allow for full data exchange for the application of the new software tools.

UMBRELLA

- Coordinated by Tennet TSO in Germany.
- Funded under FP7-ENERGY.
- http://cordis.europa.eu/news/rcn/124739
- Project website: http://www.e-umbrella.eu/


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CLEAN, GREEN AND INNOVATIVE TRANSPORT SOLUTIONS FOR CITIES

A new breed of urban public transport could fill the gap between mass and private transit options. An EU initiative has introduced a novel urban transport system based on a new generation of vehicle.

The EU-funded CATS (City alternative transport system) project represented the final stages of development of a new generation of city transport vehicles known as Cristal. The Cristal system consists of small mobility units (vehicles) that can serve two purposes.

"The NAVIA autonomous vehicle was chosen due to its similarities to the Cristal system in terms of capacity and operation principles."

The first service is a self-service option whereby users can rent a clean urban vehicle over a short term. The second is a flexible service with a professional driver to shuttle users along a line at fixed time intervals.

Three European cities (Strasbourg (France), Formello (Italy) and Ploiesti (Romania)) were studied to determine their suitability for testing the vehicles. Project partners drew on the insights of transportation system manufacturers, researchers, service providers and end users across Europe and Israel.

As Cristal vehicles could not be made available in time, other innovative vehicles were selected to be tested during the second phase of the project. The NAVIA autonomous vehicle was chosen due to its similarities to the Cristal system in terms of capacity and operation principles. The lack of a driver brought a new challenge to the project.

Demonstrations were carried out over a six-month period in Strasbourg and later in Lausanne. Following testing, the team gathered data to assess system performance and user acceptance of innovative technologies. They also studied the impact on mobility, acceptance, environment, transport patterns, accessibility and attitudes in respect of alternative transport systems.

Findings showed that the system would best serve people with reduced mobility, young passengers and tourists. To reach a wider audience, outcomes were presented at a showcase in Ploiesti to increase citizen awareness of innovative transport systems.

CATS helped test and introduce clean and innovative urban transport systems in cities. Ultimately, it will enhance urban mobility, accessibility and safety while reducing congestion, noise and carbon dioxide emissions.

CATS

- Coordinated by GEA Vallotton et Chanard Architectes-Urbanistes FSU in Switzerland.
- Funded under FP7-TRANSPORT.
- http://cordis.europa.eu/result/rcn/90815

SMART DIGITAL PLATFORM TO BOOST ENERGY EFFICIENCY IN CITIES

An EU-backed project has developed a novel online platform to substantially improve energy efficiency in both buildings and wider urban areas.

The platform, designed under the SUNSHINE (Smart UrbaN Services for HIgher eNergy Efficiency) project for city planners, industry and energy stakeholders, assesses and maps buildings' energy behaviour, and can also remotely control public street lighting. The platform has already succeeded in cutting energy use in several cities across Europe where it has been tested.

In Ferrara, Italy, about EUR 2 million was saved in energy certification costs for 10 000 buildings. Overall, there were total savings equal to around EUR 450 per year in public buildings, such as schools.

In Rovereto, Italy, energy use was cut by 19-21 % in two pilot projects, whilst in Bassano, Italy, EUR 74 was saved per street light per year — a cut of more than 50 % in energy consumption.

Meanwhile, in Zagreb, Croatia, the project achieved estimated savings of 10-30 %, while in Trentino, Italy, the city's annual electricity bill saw savings of around 7-10 %.

Mapping real energy needs

Cities use exceptionally large amounts of energy, giving them a leading role in the drive to reduce CO_2 emissions.


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Buildings account for around 40% of the total EU final energy consumption.

However, the project team realised that many key stakeholders, such as public administration officials, still lack the right knowledge about actions that could be taken to reduce energy consumption in cities and urban areas.

In order to address this, the project developed its platform to operate on three different scales: the city scale by mapping the entire cityscape, the building scale by creating awareness of a building's overall energy behaviour, and the public street lighting scale that saw the smart automation of public street lighting networks.

Using data based on available public services (such as planning information), the project created 'ecomaps' that outline the current energy consumption of an urban environment, before using them to assess the area's real energy needs and pinpointing where savings could be made. The ecomaps also allow for the energy pre-certification of buildings on an urban-wide scale.

Additionally, the SUNSHINE digital platform uses localised weather data to plan for an efficient use of heating and cooling systems within buildings to further lower urban energy usage.

Moreover, the platform allows for the interoperable control of street lighting systems based on 'Automatic meter reading' (AMR) facilities. These are accessible remotely, via interoperable standards, through the internet and through a customised smartphone/tablet App.

Additional project results and next steps

In addition to cutting energy usage, the SUNSHINE project platform has also shown that it is able to help improve municipal decision making, provide a platform for the creation of new businesses and start-ups, improve the quality of life for citizens, and stimulate further investment in energy efficiency.

The project partners now aim in the short term to intensify their training programme for relevant stakeholders, particularly public officials and urban planners.

In the longer term, they hope to engage in further research, potentially through a follow-up project funded under Horizon 2020, to further refine the SUNSHINE platform, and also to advise more cities across Europe on how the platform can be beneficially tailored to their needs.

Overall, the project has demonstrated potential for the real-time mapping and management of changes with regards to energy consumption, creating a new, flexible and dynamic means of formulating urban policy.

SUNSHINE

- Coordinated by Fondazione GraphiTech in Italy.
- Funded under CIP.
- http://cordis.europa.eu/news/rcn/124808
- Project website: http://www.sunshineproject.eu/

NEW THINKING ABOUT TRANSPORT

An EU team has assessed and helped to foster innovation in European regional transportation. The 'Smart specialisation platform' (S3P) approach yielded tailored roadmaps for each region, culminating in a set of strategic recommendations.

Europe has recognised the economic importance of innovation and the need for a strategic approach towards related goals. Transportation is one of six main sectors where such an approach should make a key difference in meeting the EU's Horizon 2020 goals.

The EU-funded METRIC project (Mapping European regional transport research and innovation capacities (METRIC)) worked on mapping capacity for transportation innovation in European regions. The study was also intended to identify respective regional competitive advantages. Based on the comparison, the team planned to prepare regional innovation roadmaps, including support for weak regions. The ultimate goal was to build regional innovation cultures that minimise risks and maximise returns.

Work focused on three main areas: mapping regional activities in transportation innovation; assessing the performance of regional frameworks; and typing and analysing the main principles of regional innovation.

For each region, the project delivered a set of recommendations regarding innovation roadmaps drawn from best practices. The roadmaps utilised the S3P approach, and the project also planned an S3P strategy for the transportation sector. The strategy is expected to facilitate structural fund investments in research and innovation, and have an impact on the development of a cohesion policy.

Investigations showed the transportation sector to be heterogeneous, consisting of several sub-sectors. Transportation service providers generally have different innovation systems. Research on regional innovation systems and environments is predominantly focused on the automotive sector, followed by the aerospace sector. Clusters in such sectors are organised around value chains.

Researchers concluded that Europe conducts considerable transportation research, at both country and regional levels. The findings will be used by policymakers to optimise the innovation strategies to be used in each region. The project's suggestions include criteria for funding and benchmarking research and innovation strategies.


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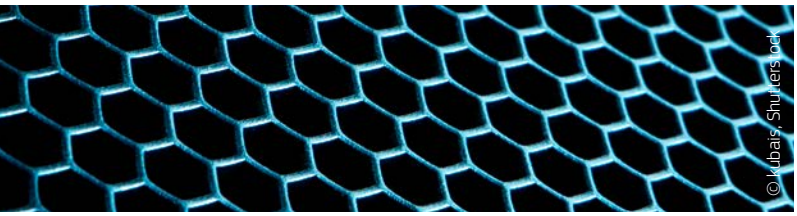
The METRIC project helped promote innovation in the transportation sector, with implications for policy, research and Europe's regional economies. The recommendations should help bring about more innovative transportation technologies.

METRIC

- Coordinated by Coventry University Enterprises Limited in the United Kingdom.
- Funded under FP7-TRANSPORT.
- http://cordis.europa.eu/result/rcn/175225
- Project website: http://www.metricfp7.eu/

NOVEL HONEYCOMB DESIGN FOR BETTER THERMOCHEMICAL ENERGY STORAGE CAPABILITIES

EU-funded researchers have successfully designed and validated an innovative redox thermochemical energy storage reactor/heat exchanger that promises to make a concrete contribution to the EU's energy and climate change ambitions.



The RESTRUCTURE (Redox Materials-based Structured Reactors/Heat Exchangers for Thermo-Chemical Heat Storage Systems in Concentrated Solar Power Plants) project, which officially ended in January 2016, conducted the validation on a semi-pilot scale system of about 74 kWh capacity constructed and operated at the Juelich Solar Tower (STJ), Germany.

Although the storage capacity was relatively low, this was the first time that such a concept had been validated under near-realistic conditions for thermochemical heat storage applications.

Producing the redox honeycombs

'The novelty of the [RESTRUCTURE] reactor design relates to the use of a monolithic honeycomb ceramic structure as its building block, in which the active material can be incorporated via several ways,' explains project coordinator Dr George Karagiannakis. 'This structure is very similar to the ceramic "bricks" used in the catalyst converters in motor vehicles.'

Regarding the materials used, Dr Karagiannakis outlined that they are metal oxide-based (e.g. cobalt oxide and manganese oxide). Substantial development was required within the project framework, in order to produce the full-scale redox honeycombs, and several challenges had to be confronted by the project team.

Prominent examples of such challenges included achieving a good compromise between structural stability under operating conditions and redox performance, as well as the scaling-up of production strategies initially developed at a laboratory scale. However, the project consortium had already anticipated most of these challenges and in several cases developed back-up options.

The advantages that monolithic honeycomb structures can provide are related to the simpler reactor design that they can offer and the inherent modularity of such a system.

'Of crucial importance, issues such as special measures to prevent high temperature drop build-up during operation, material recirculation, and extra safety measures associated with efficient particle containment in the system must be considered when "conventional" powder/small particles in fixed or moving reactor designs are targeted,' elaborated Dr Karagiannakis. 'This may increase system complexity considerably and consequently decrease overall efficiency. However, none of these issues is of particular concern when honeycomb reactor designs are considered.'

Configuration of the reactor/heat exchanger system

Throughout the duration of the project, extensive tests were first performed at lab scale to identify and validate suitable formulations. The semi-pilot system developed was an assembly of honeycombs, which were essentially scaled-up structured bodies on the basis of the small-scale test results.

The redox schemes investigated in the RESTRUCTURE project require maximum temperatures of around 1 000 degrees to be able to operate, and such high temperatures are currently not available in existing commercial CSP plants.

With a storage power capacity of about 25 kW, the system was fed by a side-stream of the hot working fluid (i.e. hot air) produced by the solar receiver at the STJ test site.

During charging, and due to the fact that the maximum temperature of hot air provided by the solar receiver was approximately 700 degrees, to achieve the required temperature of 1 000 degrees for the charging reaction, a burner was used to provide the additional heat needed. During discharge, colder air passed through the charged monolithic assembly, and heat produced was dissipated from this flow, thereby increasing its temperature at the reactor/heat exchanger outlet.

In this way, part of the energy contained in the air flow is stored in the honeycombs and the flow exits the system at a lower temperature, but still adequately high enough to drive a power cycle and produce electricity. When energy from the sun is not available, the air flow temperature drops substantially, but when forced to pass through the storage system a heat-release reaction is triggered, thereby increasing the temperature of the air, which is again used to operate the power cycle.

Post-RESTRUCTURE and next steps

Dr Karagiannakis has emphasised that the approach taken in RESTRUCTURE is considered as 'next generational' and that the technology's future commercialisation depends strongly on the successful industrial development of next generation/high temperature/high efficiency CSP technologies. This is currently in progress but outside the formal scope of the project itself.

'We are intensively seeking ways of continuing our research efforts and further developing the technology,' Dr Karagiannakis confirms. 'In particular, scaling-up and optimisation strategies are at the core of our targeted next steps.'

Overall, the project contributed towards achieving the first important step of proving the in-principle effectiveness of a new concept for thermochemical heat storage applications through the design and validation of its novel honeycomb reactor/heat exchanger.

It is now hoped that a follow-up project can be initiated to build further on the RESTRUCTURE results and advance the technology towards the pre-commercialisation phase.

RESTRUCTURE

- Coordinated by CERTH/ISFTA in Greece.
- Funded under FP7-ENERGY.
- http://cordis.europa.eu/news/rcn/124820
- Project website: http://www.restructure-project.org/

ENVIRONMENT AND SOCIETY

NOVEL METHODS TO EXTRAPOLATE ANCIENT CLIMATOLOGICAL CONDITIONS

New techniques to establish the warmest and coldest periods in recent millennia are helping to update and modernise climatological data.

The Chilean Andes represent an ecologically precious region with diverse climate pressures. The region lacks key climatological data that can help predict long-term weather patterns, a challenge that the EU-funded project CHILE1000 (Chilean lake sediments as archives for climate variability during the past 1 000 years) helped to address.

Aiming to outline quantitative summer and winter temperature reconstructions for the Chilean Andes over the past 1 000 years, the project sought to present this pivotal information in a wider spatial, temporal and climatological context. This is especially important since not enough studies have been conducted on the lakes in the region, depriving researchers of valuable paleontological data.

Using a number of new techniques, the project team produced the first-ever high-quality training set in South America for specific lake sediment spores known as chrysophyte stomatocysts. This involved the use of sediment traps and thermistors to obtain water chemistry and temperature analyses, resulting in 47 ecologically relevant environmental parameters for 24 lakes.

Subsequently, the team cross-referenced the chrysophyte stomatocyst assemblages with environmental parameters using advanced statistical analyses, representing a very accurate indicator of past winter conditions. It then extrapolated past winter-spring conditions as far back as 160 AD for Laguna Escondida, a very isolated lake in the Andes.

Interestingly, the project team found that recent cold season warming in this region over the last 40 years is not unique within a 100- or 1 000-year context. Although clear signs of warming were observed after 1980 (a trend that continues today), examples of such warming had already been seen in the last 100 years. This contrasts with records from the northern hemisphere, emphasising the importance of reconstructions based on geographical and seasonal variables.

Project achievements also include a highly detailed summer temperature reconstruction for Laguna Chepical, a glacial lake in the central Chilean Andes. The project's research results in this case have shown that the warmest period within the past 3 000 years occurred quite recently, between 1950 and 1970.

Overall, CHILE1000 helped refine technological innovations in the field and ascertained the role of chrysophyte stomatocysts as a reliable, quantitative proxy. It provided a training set for scientists and students that employs cutting-edge field techniques and statistical analyses. These positive results were highlighted in several reports and journals, contributing to paleontological and climatological science on a global scale.

CHILE1000

★ Coordinated by the University of Bern in Switzerland.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175218

CARIBBEAN ENVIRONMENTAL MANAGEMENT

An EU team has probed the complex interactions of human and ecological issues in the Caribbean. The study supplied stakeholders with information necessary to assess and modify the region's environmental management.

Latin American and Caribbean (LAC) countries have become important to debates about global environmental issues. Simultaneously, the region's social and environmental problems have led to further debates about developmental models, democratic decision-making and human-nature relations.

The EU-funded project ENGOV (Environmental governance in Latin America and the Caribbean: Developing frameworks for sustainable and equitable natural resource use) examined factors affecting environmental governance in LAC countries. The study considered obstacles and possibilities for sustainable production systems able to foster economic development while also reducing poverty and regional environmental degradation. The investigation covered nine main themes.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Researchers analysed recent initiatives and explored options for institutional innovation on the subject of natural resource use and management. The team considered formal and informal arrangements for natural resource use, including social perception and implementation.

The project met its objectives of producing the scientific knowledge that regional stakeholders need to evaluate the environmental management situation and to implement alternatives. The studies outlined progress and problems related to the theme subject, including new discourses on nature-society relations and local community actions. Other topics included new actions for environmental protection and redistributive reforms based on natural endowments.

ENGOV also addressed various topics of concern, including three particular challenges: promoting democracy, fostering food and land security, and the need to protect ecological integrity.

Results include numerous case studies and synthesising analyses, including around 100 peer-reviewed papers. Other publications include working papers, articles and books. The project's main output was a book on Latin American environmental governance, published in English, Portuguese and Spanish.

Project results were widely disseminated among relevant stakeholders via public meetings, opinion articles, policy briefs, newsletters and online training courses. Other dissemination activities included the project website and a special collection on the project's topic in an online library reading room.

The ENGOV project helped bring a new view of environmental management options to the LAC region. The work will help affected countries work together, simultaneously addressing environmental and economic problems.

"The team considered formal and informal arrangements for natural resource use, including social perception and implementation."

ENGOV

- Coordinated by the University of Amsterdam in the Netherlands.
- Funded under FP7-SSH.
- http://cordis.europa.eu/result/rcn/90131
- Project website: http://www.engov.eu/

AIR PARTICLES AND THEIR IMPACT ON CLIMATE CHANGE

A consortium of European scientists has increased our understanding of how aerosols and other airborne particles influence global climate change.

Many substances present in the atmosphere due to human activities play a dual role as climate change agents and as air pollutants. However, accurately predicting how this complex system will respond to changes in anthropogenic sources is very difficult. This is because even altering a single component can result in disproportionate effects elsewhere, having an enormous influence on the behaviour of the entire system.


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"One of the consortium's major achievements was the collection of the most comprehensive aerosol data set to date."

To limit climate change and reduce air pollution, which claims 2 million lives each year, a better understanding of these interactions is needed. Therefore, the PEGASOS (Pan-European gas-aerosol-climate interaction study) project was set up to clarify these crucial issues and develop better estimates of air pollution in Europe and its impact on climate.

The PEGASOS consortium quantified the extent of both regional and global feedbacks between atmospheric chemistry and a shifting climate. Furthermore, researchers identified mitigation strategies and policies that will both improve air quality and limit the effects of aerosols on the climate.

Scientists conducted a number of laboratory studies to improve the parameters used in atmospheric pollution models. Most of these focused on the interactions of aerosols with other components of the atmosphere, and the formation of secondary aerosols.

For the first time, an airship was used to conduct field studies, observing radicals and aerosols in the atmospheric layers close to the ground over Europe. One of the consortium's major achievements was the collection of the most comprehensive aerosol data set to date. This information was also used to improve atmospheric models.

Researchers created or improved upon several models of atmospheric processes on a both regional and global scale. These were validated through hindcasting (predicting past conditions to judge how accurate a model is) before being used for short-term future forecasts.

PEGASOS outcomes will help to support the European Commission's Thematic Strategy on Air Pollution and Air Quality regulation. They will also help to provide a more accurate quantification of regional and global links between air pollution and climate change. These will be used to provide more accurate forecasts and predictions, and underpin mitigation options and other policy initiatives.

PEGASOS

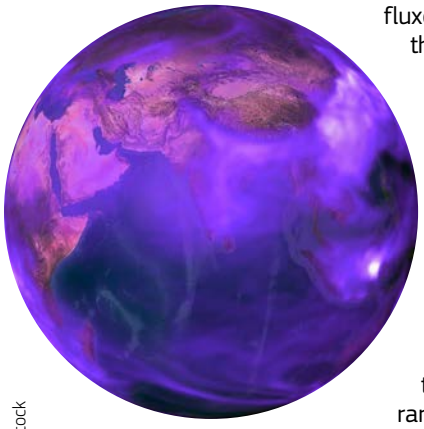
- Coordinated by the Foundation for Research and Technology Hellas in Greece.
- Funded under FP7-ENVIRONMENT.
- http://cordis.europa.eu/result/rcn/90193
- Project website: http://pegasos.iceht.forth.gr/

OBSERVATION OF GLOBAL CARBON CYCLE

Current global observational and modelling capabilities allow scientists to produce estimates of the carbon budget, but many uncertainties remain. An EU-funded initiative was therefore set up to provide more and better data on 'carbon dioxide' (CO_2) and 'methane' (CH_4) through a global carbon observation and analysis system.

The GEOCARBON (Operational global carbon observing system) project designed a coordinated global carbon observation and analysis system. Consortium members also provided a set of harmonised global carbon data and developed improved carbon cycle data assimilation systems.

Researchers systematically collected and organised bottom-up estimates of land-atmosphere, coastal and ocean-atmosphere fluxes. This provided a comprehensive and entirely data-driven update of the major stocks and fluxes in the global carbon cycle. Models quantifying the carbon



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fluxes and stocks as well as their abatement potential were also improved and coupled with integrated assessment models. The aim was to quantify the economic value of an enhanced global carbon observation system.

Results were based on the combination of a range of data, algorithms, statistics and model estimates, and their interpretation. The project's integrated approach helped to disentangle many different components of the global carbon cycle. It also addressed in more detail some specific aspects of the global carbon cycle, such as CH_4 (in addition to CO_2) and the role of tropical areas, two key elements not fully studied previously.

GEOCARBON provided an aggregated and harmonised set of data and information on carbon pools, sources and sinks, thereby improving understanding of the carbon cycle and its role in climate change. It also supports monitoring-based decision-making and related environmental treaty obligations, and contributes to achieving the GEOSS 2015 (Global Earth Observation System of Systems) climate target.

GEOCARBON

- Coordinated by the Euro-Mediterranean Center for Climate Change in Italy.
- Funded under FP7-ENVIRONMENT.
- http://cordis.europa.eu/result/rcn/92199
- Project website: http://www.geocarbon.net/

UNDERSTANDING FOREST LITTER FOR BETTER CLIMATE MODELS

Carbon that has been returned to the atmosphere through the breakdown of forest litter is a major component of the global carbon cycle. Therefore, an EU-funded study to understand the biotic and abiotic factors controlling decomposition has important implications for present and future global carbon budgets.

The DECOMFORECO (Litter decomposition in forest ecosystems: Assessing the functional role of climate, litter quality and soil organisms) project examined the link between biodiversity and decomposition along climatic gradients in forest ecosystems. Unlike previous investigations, the work focused on the effects of functional biodiversity at the three trophic levels of producer, decomposers and detritivores, rather than on taxonomy. The aim was to link aboveground and belowground diversity with decomposition.

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Scientists compared the effects of plant litter and decomposer diversity between terrestrial and aquatic ecosystems at the continental scale and for individual biomes. A biome is an area of the world that has a particular climate and contains particular plants and animals.

Researchers also selected 10 sites at the regional scale in southern France and examined the effect of climate change, biodiversity of litter and soil organisms on litter decomposition. At the local scale, they determined the effects of soil microbes and litter quality on both leaf and root litter decomposition in response to an experimental drought.

Results showed that micronutrients within the litter layer and environmental variation among biomes were the main drivers of litter carbon loss in both aquatic and terrestrial ecosystems. These findings will be used to improve coupled terrestrial-aquatic ecosystem carbon models.

At the regional scale, researchers found that the level of phenols and decomposer organisms in the leaf litter and decomposer organisms varied during the decomposition process. They also found that although climate and litter quality explained most of the variance in litter carbon, large animals also play an important role.

Experiments in the field and in the laboratory revealed that a reduction in microorganisms and rainfall promoted litter (but not leaf) decomposition in the area of the lower, finer roots. This suggests that contrasting mechanisms are responsible for driving the indirect effects of drought on above- and belowground litter decomposition. Understanding these mechanisms and measuring their effect in drought situations is critical for an accurate integration of litter decomposition in the role of carbon in Mediterranean ecosystems experiencing climate change.

DECOMFORECO therefore provided experimental evidence for incorporating the factors responsible for litter decomposition over time and across different ecosystems into predictions for climate change effects on the carbon cycle.

DECOMFORECO

- Coordinated by CNRS in France.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/175220
- Project website: https://www.sites.google.com/site/pablogarciapalacios1/home/Marie-Curie-Project

IT AND TELECOMMUNICATIONS

A NEW BANDWIDTH VARIABLE TRANSMITTER TO BUILD FUTURE OPTICAL NETWORKS

Researchers working within the EU-funded IDEALIST project have developed a new 'Bandwidth variable transmitter' (BVT) that could become a vital element in enabling optical networks with seamless network optimisation and flexibility.

Traffic demand is seeing a continued growth of about 35% due to the proliferation of high bandwidth applications, placing greater strain on optical networks. Moreover, traffic requirements are fluid, varying at different times of the day but also due to evolving consumer and business demands.

With this continued growth in network demands and data traffic, there is an urgent need for the development of elastic optical networks, flexible enough to handle a wide range of data types and transmission rates.

The BVT prototype will contribute to fulfilling this need by being able to transmit data in optical transmission networks with a bit rate change in a hitless manner. Assembled by IDEALIST (Industry-Driven Elastic and Adaptive Lambda Infrastructure for Service and Transport Networks) project partners Bell Labs in France, it converts electronic signals to optical signals, but with a bandwidth that changes depending on the level of demand. It works without service interruptions, an advantage known as being 'hitless.'

Changing the signal rate for hitless functioning

Most conventional BVTs function by changing the format of the optical signal, converting between digital and analogue formats. The new BVT created by Nokia Bell Labs changes the signal rate, which is also known as the Baud or modulation rate. This is the number of signal events transmitted per second, with a single second event potentially encoding up to several pieces of information.

The advantage of focusing on the signal rate is that it is easier to implement with electronics and is cost-effective.

This approach incorporates smart processing and makes the transmitter hitless, allowing it to continue functioning regardless of interruption and data loss. This is a particularly innovative development, as transmitters normally have to reconfigure themselves when interrupted, which can take up to several minutes and subsequently causes a halt in traffic.

The prototype is connected to a commercially available optical transport network switch that aggregates many different signals, such as video and audio, and sends it through the transmitter. It works typically at a bit rate of between 10 and 107 Gigabits per second.

For the next step, the BVT will be tested in the field with network operators, integrating it with the management software and systems that control a network from end-to-end.

Building tomorrow's optical network

Overall, the new device will be just one component in a much larger and more sophisticated flexible optical network being developed by the IDEALIST consortium.

Many of the devices needed to build such a network already exist, including BVTs, but the new prototype is paving the way to ensure that these existing solutions are also fully capable of adapting and innovating to meet the requirements of tomorrow's optical networks.

The project is committed to researching in detail and providing solutions for the most promising technology in order to meet the demands of the next generation optical transport network, and to engineer a fully functioning elastic optical network architecture.

This would provide much of the necessary infrastructure for achieving the highly ambitious goals set by the EU's Digital Market Strategy.

IDEALIST

- ★ Coordinated by Telefonica Research and Development in Spain.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/news/rcn/124807
- ★ Project website: http://www.ict-idealist.eu/

NOVEL SEMANTIC TAGGING TOOL TO BENEFIT DIGITAL JOURNALISM

Researchers from the EU-funded MICO project have published highly promising results. These will help independent news organisations in extending their publishing workflows with cross-media analysis and linked data querying tools.

The project primarily worked with two partners, Greenpeace Italy and Shoof (a start-up developing an Android app for user generated content). It focused on organising the news desk of small and medium editorial teams by creating a flexible network of metadata around both text and media.

The MICO (Media in Context) project researchers learnt that placing news online without providing adequate context and analysis simply did not work, as the focus for digital news has shifted towards interactive engagement and fostering a sense of community.

By developing their semantic editor, called WordLift (a plugin for WordPress), and then having it utilised by Greenpeace Italy on their magazine website, the project team saw that structuring content with a classification scheme would provide the context needed for news stories.

"MICO researchers have learnt through this stage of the project that journalists need technology to assist their work but this technology should not require too much of their attention."

News content is now indeed being republished in many different forms and on many different platforms and devices.

This in turn allowed the team to realise that by structuring content and creating multiple access points (in the form of web pages), overall content discoverability over social networks and search engines increased dramatically.

By using semantic tagging — in essence tagging information with a specific term or resource — every content publisher begins curating a set of concepts that emerge from the content being produced and analysed. In WordLift, these concepts are compiled by applying an internal vocabulary.

During validation tests with Greenpeace Italy, it was shown that this internal vocabulary brought a new level of self-awareness to the organisation. The editorial team began studying more carefully the relationship between the organisation, the concepts they used for tagging and their target audience.

Seamless technology

Overall, this process has helped them to make strategic editorial decisions by considering what connects to what and why.

The project team is still gathering the full data, but it is clear that classifying news content with a clear scheme is increasing both engagement and traffic.

Overall, MICO researchers have learnt through this stage of the project that journalists need technology to assist their work but this technology should not require too much of their attention.

The primary aim for journalists is to concentrate on writing engaging stories and creating meaningful relationships with their target audiences.

However, tools such as WordLift have proven their ability to help provide them with the all-important content structure and context that is increasingly essential in the digital age for engaging, capturing and retaining target audiences.

MICO

- Coordinated by Salzburg Research in Austria.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/124742
- Project website: http://www.mico-project.eu/

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NEW TOOLS DEVELOPED TO HELP SMES EFFICIENTLY SCALE UP CLOUD SERVICES

An EU project has developed tools to build scalable cloud applications, which will help boost SME performance and benefit business as a whole.

The idea is to enable end users such as SMEs, big businesses and public institutions to exploit the flexibility of the Cloud by gradually building up their computing capacities. These new downloadable tools will also give online developers the opportunity to offer solutions that are better tailored to customers.

The EU-funded CLOUDSCALE (Scalability management for Cloud Computing) project will also directly help SMEs looking to expand their cloud-based services. If a successful online application is experiencing rapidly rising user numbers, for example, this can lead to higher and higher costs and — especially during peak loads — slower response times.

CLOUDSCALE's tools would enable this SME to analyse the scalability problem in detail and to identify bottlenecks within the application. They can then find the best scalable architecture and restructure their application.

Cloud computing revolution

Cloud computing, which is about sharing computing resources rather than having local servers or personal devices handle each individual application, is a highly efficient means of delivering services to an organisation's computers and devices through the internet. It offers end users potentially unlimited resources for their applications on an on-demand basis.

This shared IT infrastructure contains pools of systems that are linked together, with specialised connections spreading data-processing chores across them. This means that high-performance computing power used to perform tens of trillions of computations per second can be tapped into for consumer-oriented applications such as financial transactions and data storage or to power immersive multi-user online computer games.

Cloud business models and technologies however can be difficult to get scaled up efficiently, often requiring advanced software engineering methods. Implementing systems without properly taking into account scalability can lead to either low performance (due to 'under provisioning', resulting in low throughput) or high costs (due to 'over provisioning', caused by low utilisation of resources).

CLOUDSCALE solutions

The solutions developed through the CLOUDSCALE project aim to address this by using minimal computational resources to accurately assess the scalability of certain cloud-based services quickly and efficiently.

CLOUDSCALE Environment for example is a desktop application that integrates the different tools developed by the project, and can be installed and used on virtually any personal computer. One of these tools is CLOUDSCALE's Analyser, which allows users to accurately assess the scalability, elasticity and efficiency of cloud computing applications. Another is the Extractor, a reverse engineering tool for automatic model extraction.

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Another newly developed tool is called DynamicSpotter. This tool can automatically detect software performance problems in Java-based enterprise software systems. Static Spotter is another reverse engineering tool, which can automatically detect so-called search patterns that can influence scalability.

All of these tools are available for download on the project's website. Ensuring industry relevance has been central throughout the project, as a greater uptake of CLOUDSCALE tools will help ensure that scalability becomes less of a problem for businesses and institutions looking to put in place cost-effective, flexible cloud-based systems.

Following the recent successful completion of the project, end users are free to try CLOUDSCALE Environment and other tools, and can contact the project coordinator if they have any questions or suggestions.

CLOUDSCALE

- Coordinated by SINTEF in Norway.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/124821
- Project website: http://www.cloudscale-project.eu/
- http://bit.ly/1QGXfPe

INTERACTIVE TOOLS TO FACILITATE FURTHER COOPERATION ON RESPONSIBLE RESEARCH AND INNOVATION

An EU project has developed two interactive online tools to assist in the dissemination of best practices for 'Responsible research and innovation' (RRI).

During the 'RRI: Shaping New Horizons' conference that was held on 14 and 15 January 2016 in Brussels, the RESPONSIBILITY (Global Model and Observatory for International Responsible Research and Innovation Coordination) project presented its key successes, including how it has created a virtual Observatory and Forum that facilitates the adoption and diffusion of a common understanding of RRI across the globe.

As a reference framework, the project partners began by asking themselves two key questions: What are the benefits of an RRI community and, most crucial, how can an RRI community be built most effectively and with the most added value for stakeholders?

In order to begin answering these questions, the project started in its early phase to collect and disseminate best practices, amass a number of applicable case studies, and begin building a network of scientists to strengthen collaboration on RRI issues in many interdisciplinary fields.

From here, the project was able to begin putting in motion the creation process for its two key aims: the construction of the Forum and Observatory.

The RESPONSIBILITY Forum

The RESPONSIBILITY Forum is an online tool that is self-regulated, transparent, remote and open to all interested stakeholders. The main objective of the Forum is to be an interface between many different actors interested in RRI, including researchers, policy makers, civil society and industry representatives and CSOs. The Forum will also prepare RRI outcomes that are relevant to both political actors and industry.

However, the Forum is designed to be not just a simple talking shop for RRI stakeholders. The project has also envisioned it will allow participants to actively advertise for new RRI projects, submit new calls for applications, post job vacancies, apply for new funding sources, and publicise calls for partnerships in new projects.

'The aim of the project is to provide an incentive for users to visit the site, and subsequently raise its profile amongst RRI-interested stakeholders,' commented project team member, Mohamad Ajami.

Discussions that take place in the Forum, and their outcomes, are then supposed to provide the necessary content for the project's second tool, the Observatory.

The RESPONSIBILITY Observatory

The RESPONSIBILITY Observatory of Responsible Research and Innovation will be established as a permanent point of reference and actual forethought with regards to the current concept of, and developments in, the field of RRI.

With RRI evolving rapidly as a concept due to new technologies and changing attitudes, the Observatory is designed to be a single repository for RRI literature, projects and initiatives that already exist. The tool uses an in-built search engine that will allow users to obtain an overview of the most read and most linked documents. Entries into the database are also tagged and archived in a manner which meets the needs of particular RRI actors.

Like the Forum, the Observatory is also meant to have an interactive element, so it is designed to allow any interested stakeholder to upload and/or engage in a particular RRI topic or discussion. The Observatory will also allow researchers to identify areas in need of more detailed research, and it will identify where public engagement on particular issues might be relevant.

'What makes the tool so special is that it doesn't just provide an observatory for the RRI community, but it also takes advantage of the RRI community itself — it uses the "wisdom of the crowd" as a virtual place to clarify, develop, and discuss the concept of RRI,' project coordinator Dr Aki Zaharya Menevidis said.

The Forum and Observatory tools developed by RESPONSIBILITY will act as crucial lynchpins over the coming years in furthering the development and dissemination of RRI principles and practices across both the policy and scientific and research fields.

RESPONSIBILITY
- ★ Coordinated by Fraunhofer in Germany.
- ★ Funded under FP7-SIS.
- ★ http://cordis.europa.eu/news/rcn/124680
- ★ Project website: http://responsibility-rri.eu/

NEW SOFTWARE TOOL SUPPORTS ADVANCED APPLICATION DEVELOPMENT AND MODELLING

Modern computer chips are requiring more advanced software, which needs to be thoroughly developed and tested before it is marketed. A novel software tool will help achieve this aim.

The advent of faster, more powerful computing chips is prompting developers to create more productive and efficient software, fuelled by huge investment in the sector. The EU-funded MADAME (Manycore application development and modeling environment) project investigated programme development, optimisation and deployment of parallel applications for current and future manycore and multicore architectures.

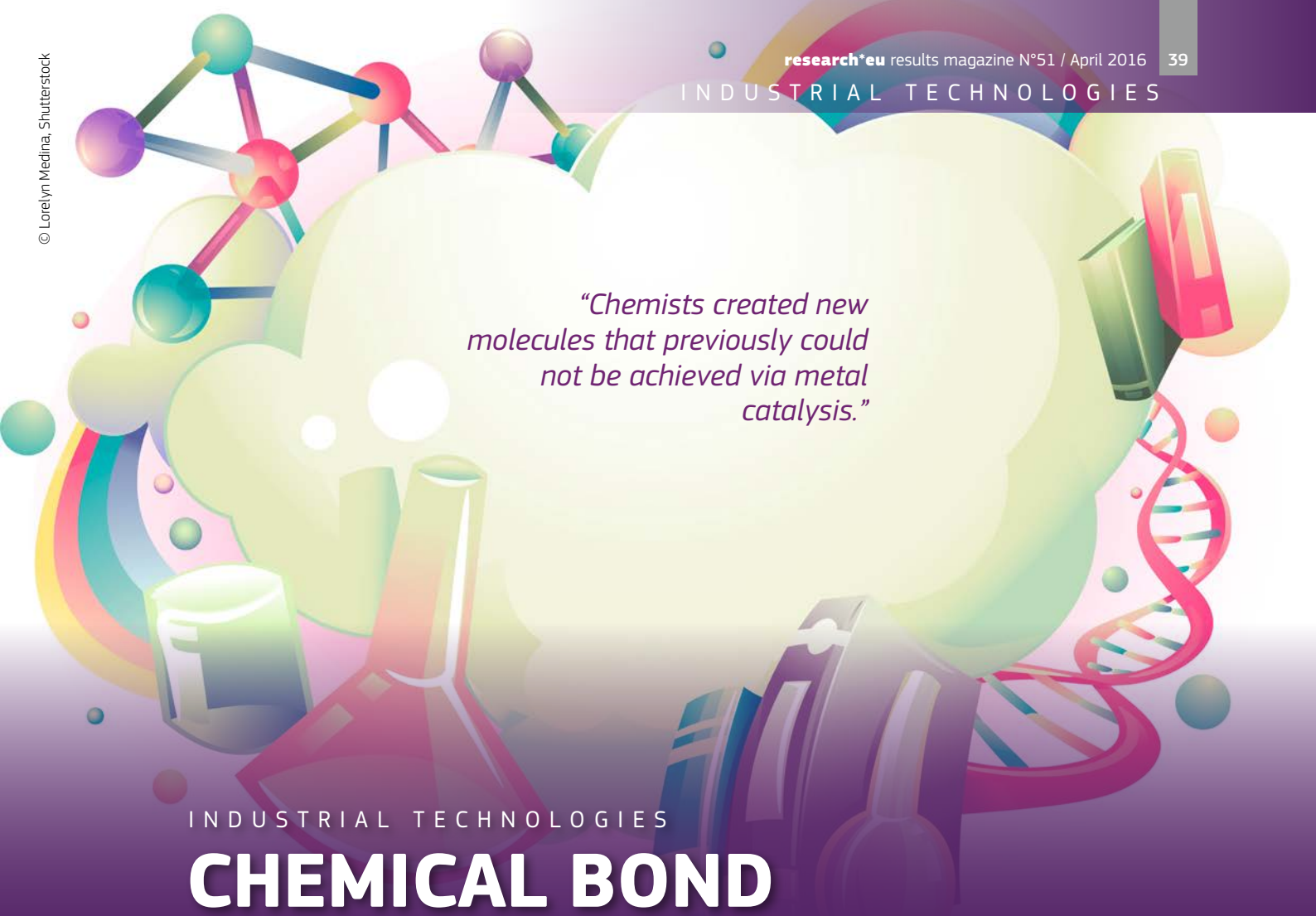
"The project team worked with an application programming interface that supports multi-platform shared memory multiprocessing programming known as OpenMP."

To achieve its aims, the project team worked with an application programming interface that supports multi-platform shared memory multiprocessing programming known as OpenMP. It strove to develop an efficient, versatile, user-friendly and portable monitoring solution for programming paradigms of the multicore and manycore era.

Another main project objective was to develop a modelling framework to support developers in answering critical questions such as the potential benefits of exploiting accelerators. The resulting models are useful during application development and tuning, as well as during deployment and runtime in modern manycore operating systems.

As a result of its research, MADAME developed ompP, a viable profiling tool for OpenMP applications. The software successfully creates a profiling report in a human-readable ASCII format, supporting the measurement of hardware performance counters using PAPI. The tool also supports productivity features such as overhead analysis and detection of common inefficiency situations. It can be downloaded from the project website along with several publications on the topic.

MADAME
- ★ Coordinated by LMU Munich in Germany.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/175178
- ★ Project website: http://ompp-tool.com/



"Chemists created new molecules that previously could not be achieved via metal catalysis."

INDUSTRIAL TECHNOLOGIES

CHEMICAL BOND FORMATION SIMPLIFIED

Organic chemists may revolutionise the chemical and drug industries by quickly and cheaply converting abundant compounds into valuable organic molecules.

Most organic compounds contain molecules with carbon atoms bonded to hydrogen atoms. This so-called C-H bond is very unreactive and difficult to break, making it tricky for organic chemists to create new bonds when making organic compounds.

The EU-funded DASCA (Direct alkylation of saturated cyclic amines via catalytic C-H functionalization) project developed a way to directly convert C-H bonds into 'carbon-carbon' (C-C) bonds. These bonds are particularly important for producing useful chemicals like pharmaceuticals and plastics.

Traditionally, replacing hydrogen in a C-H bond with another carbon (or any other atom) is a lengthy process requiring multiple steps. DASCA instead used a metal to activate the reaction in a procedure known as catalysis. The 'metal' (M) atom is inserted into the C-H bond, cleaving it and creating a C-M intermediate that can be used to create new compounds.

To demonstrate this new technique, researchers used the metal ruthenium to transform bonds in a nitrogen-containing compound to create new organic molecules. These may in turn be used to discover novel drugs.

Researchers also developed reagents that are attached to either the nitrogen atom in the organic compound or the compound's carbon skeleton. These 'directing groups' selectively guide the C-H to C-C bond formation in specific positions, depending on where the directing group is bound in the molecule.

Using these approaches, chemists created new molecules that previously could not be achieved via metal catalysis. This technology will be extremely useful for producing organic molecules more cheaply and easily, particularly in the field of drug discovery.

DASCA

- ★ Coordinated by the University of Antwerp in Belgium.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/175198

NEW ENVIRONMENTALLY FRIENDLY FIBRE-REINFORCED CEMENT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EU researchers have developed a new type of 'Fibre-reinforced cement' (FRC). It offers improved performance and reduced environmental impacts compared to traditional FRC-based products currently on the market.

FRC is a tough and damage-resistant building material that plays a key role in the construction industry. But, for every tonne of FRC manufactured, nearly a tonne of 'carbon dioxide' (CO_2) waste is generated.

The EU-backed FIBCEM (Nanotechnology enhanced extruded fibre reinforced foam cement based environmentally friendly sandwich material for building applications) project addressed this problem by creating a more eco-friendly product.

Project partners developed an advanced low-density composite material with a lower CO_2 footprint. This was achieved by using a foam core to replace part of the cement with materials such as fly ash and silica fume, and the use of a low-energy extrusion manufacturing process.

The material developed, known as FIBCEM Plan B, offers better environmental results in all impact categories compared to equivalent commercial products. It also shows similar acoustic properties, thermal properties and fire-proof capability to existing FRC-based products.

Low density was achieved by incorporating air by means of 'superabsorbent polymers' (SAPs) and 'chemical foaming agents' (CFAs). Researchers concluded that SAPs work well for controlled cell porosity generation and that adding SAPs promotes cement hydration.

The team developed and tested nanoclay particles for use in the cement skin and experimented with modifications that would enhance various properties of the material. The surface-modified nanoclays were made compatible with FRC and cement foams by selected surfactant and dispersant, which enabled uniform dispersions of nanoclays. Recommendations on the ratio of the agents to organoclay were made to account for the adsorption of nanoclay particles.

The developed core and skin materials were extruded separately. Following the extrusion process, a FIBCEM 'sandwich' material was experimentally made by combining the layers.

The product samples made under Plan B for the test were not extruded.

The potential of the product made under Plan B has to be evaluated further prior to deciding on future actions.

FIBCEM

- Coordinated by Cembrit Holding in Denmark.
- Funded under FP7-NMP.
- http://cordis.europa.eu/result/rcn/150408
- Project website: http://www.fibcem.com/

SANITISING WASTEWATER WITH UV LIGHT

Our water resources are increasingly contaminated by large volumes of wastewater from industrial processes; therefore, there is an urgent need for a water treatment system. This need to protect water resources is also reflected in legislation such as the European Water Framework Directive (WFD) and the Directive on integrated pollution prevention and control.

The EU-funded L4CW-DEMO (Demonstration of a novel system to breakdown hazardous substances in wastewater streams into harmless bio-friendly compounds using multi-chromatic UV light) project developed a cost-effective pilot system for safely treating toxic organic waste streams. The system uses an advanced oxidation process based on a multi-chromatic 'ultraviolet' (UV) source to break down hazardous substances into harmless bio-friendly compounds, without generating any toxic by-products.

Project partners developed the manufacturing process for the lamp system and the associated glass technology. Glass subunits were fabricated and tested for mechanical stability, UV emission and their ability to break down artificial wastewater. In addition, the consortium updated a database of wastewaters that would benefit from the improved cost effectiveness of this form of treatment.

The production process involved a number of steps such as glass shaping, filling the quartz cavity with gas to the required pressure and ensuring safety during automated production. Data was also collected so that a product life-cycle analysis could be conducted.

Testing protocols were carried out to ensure product quality was met and energy input into the UV reactor was optimised to increase power efficiency. The team redeveloped UV reactor parts to guarantee that they were suited to automated production. They also improved the process control and sensing system that was developed in an earlier initiative.

The consortium successfully achieved automated production of UV reactors and optimised the treatment unit with regard to sensing and control. It also demonstrated the new UV wastewater treatment technology over extended periods of time.

This enabled the collection of base data for product life-cycle analysis and for rates in relation to customer investment calculations. Furthermore, use of the UV multi-chromatic light process to treat hazardous organic materials in wastewaters and turn them into bio-friendly compounds was tested and proven and is ready for commercialisation.

L4CW-DEMO's technology will generate significant benefits for society by reducing organic pollution from industrial sites prior to discharge into sewage works. Discharge costs to the enterprises can be lowered, and in certain applications water reuse will be enabled. In addition, more economic and environmental wastewater treatment technologies will also help water-scarce regions to attract new industrial activity without having to invest in additional water sourcing and wastewater treatment sites.

L4CW-DEMO

- Coordinated by SICO Technology in Austria.
- Funded under FP7-SME.
- http://cordis.europa.eu/result/rcn/92725
- Project website: http://www.l4cw.eu/

SECURITY AND SAFETY

THE QUEST TO DETECT BOMBS BEFORE THEY ARE EVEN MADE

High-tech sensors placed in sewer systems across European cities could one day help detect and dismantle bombs before they explode. The technology is already available.

In a more volatile world that has seen an increase in terrorist attacks, detecting explosive devices is crucial to saving lives and disempowering terrorists. So far, detection has focused on the stage when an explosive charge is ready for use and on the way to the scene of the attack. With this in mind, experts are looking at ways to locate explosive material at a very early stage, for example during preparation.

The EU-funded EMPHASIS (Explosive material production (hidden) agile search and intelligence system) project looked at detecting precursors used to make explosives, including by-products from chemical synthesis that escape in the air or sewers during production. It worked on a system for detecting illicit production of explosives and 'improvised explosive devices' (IEDs) in urban areas using sophisticated infrared and Raman technologies.

The project team, led by the Swedish Defence Research Agency, tested a prototype system made of a series of sensors placed in sewage systems to monitor traces or vapour from precursors or explosives. The information is processed in a command centre to detect elevated amounts, documenting date, time and concentration levels as well, in order to help pinpoint the existence of a possible bomb-making locale.

The final system demonstration, which gathered together 94 participants from 13 countries, including the United States, and was conducted jointly with another EU project called BONAS, proved successful at reading sensor data and displaying it on a map. It validated the concept in specific scenarios, paving the way for more technical development in the field. The technology may prove very useful in countering terrorism, bomb production, piracy, drug production and drug smuggling, in addition to helping safeguard airports, pipelines and production plants.

EMPHASIS

- Coordinated by the Swedish Defence Research Agency in Sweden.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/175221
- Project website: http://www.emphasis-fp7.eu/

NEXT-GENERATION CRYPTOGRAPHIC TECHNIQUES TO ENHANCE PRIVACY

Although contemporary cryptographic techniques guard transactions from hackers, they often do not provide an adequate balance between the privacy and utility of stored data. In fact, data utility is often grafted on top of the cryptographic mechanisms through monolithic key management.

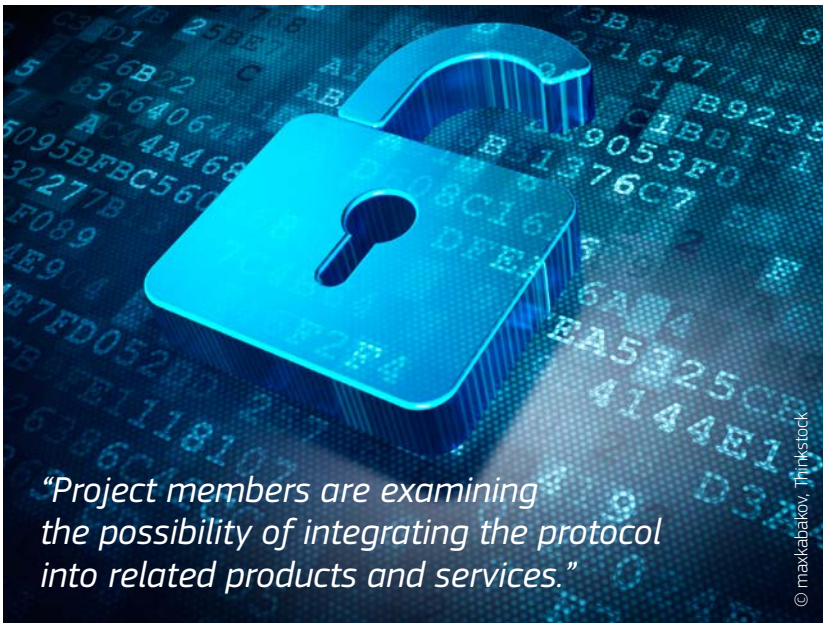
The EU-backed RECUP (Cryptographic techniques for reconciling utility with privacy in computer systems) project tackled this privacy-utility conundrum by finding ways of optimally protecting the user and provider of a service, without reducing the usability of the data.

RECUP developed security models and new encryption and authentication protocols that extend so-called fine-grain privacy controls. The focus was on cryptographic techniques that can be used to provide more effective key management procedures. The team also developed new models and protocols for operations such as encryption and authentication.

Modelling efforts dealt with all the basic cryptographic operations involved when a hacker tries to tamper with the internal state of the primitive.

Project partners studied and developed methods to utilise distributed systems that minimise vulnerability through special algorithms. The algorithms exploit any given entity in the network only once for a particular abstract operation. They also studied the issue of privacy-preserving aggregation of distributed data.

To enhance data security, the team invented a technique known as secure in-network processing of exact SUM queries, which is highly secure yet bandwidth friendly.



A new distributed password-based authenticated key exchange protocol was developed. This will help provide very efficient password-protected services for various highly mobile users who employ different devices. Project members are examining the possibility of integrating the protocol into related products and services.

RECUP introduced cryptographic technology so that computer systems and networks can carry sensitive data in a better manner. Government, industry and the general public will benefit from data management approaches that minimise risks of unintended exposure to sensitive information.

RECUP

- Coordinated by the National and Kapodistrian University of Athens in Greece.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/91872
- Project website: http://crypto.di.uoa.gr/CRYPTO.SEC/RECUP.html

RELIABLY E-BOOSTING NUCLEAR POWER SAFETY

Joint efforts between China and the EU have helped to ensure that the nuclear power industry has state-of-the-art methods and data for assessing safety-critical software.

Modern nuclear power plants require digital 'Instrumentation and control' (I&C) systems that can reliably monitor all operational aspects and dynamically make adjustments to ensure safety. Software in such systems requires an assessment approach to ensure that they are as fault-free as possible. Moreover, differences in licensing approaches adopted in each country hinder the establishment of best practices.

"The researchers proposed a framework for software verification integrating rule-based, goal-based and risk-informed approaches."

In the context of the EU-funded project HARMONICS (Harmonised assessment of reliability of modern nuclear I&C software), five European countries collaborated with China to provide support to the nuclear power industry in evaluating the software of safety-critical systems.

HARMONICS researchers built on the results of two previous research projects, namely CEMSIS (Cost effective modernisation of systems important to safety) and BE-SECBS (Benchmark exercise on safety evaluation of computer based systems). In addition, the end-users' needs and experiences in China and the EU were reviewed.

Before the end of the project, the researchers proposed a framework for software verification integrating rule-based,

goal-based and risk-informed approaches. The goal-based approach requires a complete and coherent initial set of goals. The rule-based approach alone is insufficient as it cannot by itself demonstrate that a system is safe enough for a given application.

The applicability and acceptability of each approach were tested in a series of case studies of digital protection systems. The results were used to provide practical guidelines for integrating the three approaches to get a consistent process for verifying digital I&C systems. The HARMONICS project also investigated static source code analysis and formal verification.

HARMONICS activities have provided a sound basis for testing digital I&C technologies used in nuclear power plants to ensure efficiency and safety. Licensing of digital I&C systems is expected to become more transparent while harmonisation of I&C systems among European countries and beyond could facilitate the sharing of best practices.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HARMONICS

- Coordinated by the VTT Technical Research Centre in Finland.
- Funded under FP7-EURATOM-FISSION.
- http://cordis.europa.eu/result/rcn/90954
- Project website: http://harmonics.vtt.fi/

IN-DEPTH PERSPECTIVE OF EUROPEAN CITIZENS ON SURVEILLANCE, PRIVACY AND SECURITY

Does more security invariably lead to less privacy? An EU initiative looked into the trade-off thinking between privacy and security in order to provide new insight into the links between surveillance, privacy and security.

European politicians and decision-makers assume that citizens automatically consent to security measures that involve surveillance, and that they want and accept a very high degree of public and private surveillance in daily life to feel safe and secure. However, surveillance technologies and practices do not necessarily reflect the views of citizens.

With this perceived trade-off in mind, the EU-funded SURPRISE (Surveillance, privacy and security: A large scale participatory assessment of criteria and factors determining acceptability and acceptance of security technologies in Europe) project explored the views of Europeans to spark an informed debate on security policies and their effect on privacy.


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Project partners mapped key security challenges and related security policies and technologies. Criteria and factors that affect the acceptance and acceptability of 'surveillance-oriented security technologies' (SOSTs) were identified, assessed and tested. They identified and elaborated on options to influence security measures in order to conform with ethical and privacy requirements from a technical, legal and social standpoint. Based on these outcomes, a theoretical model of criteria and factors that impact acceptability was developed and tested empirically. It showed that the trade-off approach is by far oversimplifying reality, therefore it is not suitable for informing policy-making adequately.

To gauge citizens' attitudes towards the relationship between surveillance and security and towards specific surveillance technologies, a series of large-scale summits and smaller meetings were held and involved about 2 000 participants in nine European countries.

Results of the participatory events were analysed, providing a better understanding of SOSTs assessment by Europeans and reasons for accepting or rejecting specific measures and technologies. This led to 16 policy recommendations. Results were also used to develop a decision-support system to facilitate the involvement of citizens in decision-making concerning security measures and technologies.

"Project partners mapped key security challenges and related security policies and technologies."

Through SURPRISE, the voice of Europeans on surveillance, privacy and security has been heard. It will ultimately contribute to the development of security policies and measures that are consistent with human rights and European values.

SURPRISE

- Coordinated by the Austrian Academy of Sciences in Austria.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/175191

SPACE

NEW MAGNETIC RADIATION SHIELDING TO PROTECT ASTRONAUTS DURING DEEP SPACE MISSIONS

An EU-funded project has provided tangible technological solutions for protecting deep space astronauts from harmful radiation.

Following the end of the SR2S (Space Radiation Superconductive Shield) project in December 2015, scientists now have the knowledge and tools required to develop magnetic shielding structures to protect astronauts from radiation exposure caused by Galactic Cosmic Rays. Long-term radiation exposure whilst in space greatly increases an astronaut's risk of developing certain types of cancer.

To evaluate the feasibility of producing such a shield, the project focused on superconductors, materials that have no electrical resistance at extremely low temperatures, to help them overcome one of the biggest challenges faced by the team — the weight of the large magnet required. In deep space, the addition of an extra 1 kg to the spacecraft would result in an additional cost of USD 15 000 to the whole mission.

Currently, superconductors have only been found to work whilst in extremely cold environments, not much higher than absolute zero. The temperature of deep space offers one of the only natural environments where deploying this type of technology is not only possible but actually extremely useful as well.

The researchers have presented several shielding structures that could overcome this challenge, particularly achievement of the so-called 'pumpkin structure'. This is an active shield configuration that crucially is lightweight and thus suitable for long duration deep space missions. The structure works by reducing the material crossed by incident particles, thereby avoiding the generation of secondary particles and as a result generating a more efficient shield.

By adopting this design, the magnetic shield was 3 000 times stronger than the Earth's and should be able to project a 10-metre force field that would deflect cosmic rays around the surface of the spacecraft, protecting the astronauts inside.

In particular, 'magnesium diboride' (MgB_2) could be the material of choice for creating the force field. Italian company Columbus Superconductors, one of the partners in the SR2S project, has used MgB_2 cables and wires in a variety of ways, from medical applications to magnetic levitation systems for transportation. This has also highlighted the secondary finding that the technology could also be utilised on Earth in a number of other fields, including healthcare and power generation.

It could still be many years before such technology is ready to be actively deployed for deep space manned missions, but further tests of the SR2S technology will continue to be conducted in the short to mid-term.

The project itself has shown the clear potential for collaboration between European researchers and industry in the pursuit of a common European Space Policy.

Consequently, the promising technological results from the project have brought the notion of preparing astronauts for deep space missions that are now not possible for humans that little bit closer to reality.

SR2S

- Coordinated by INFN in Italy.
- Funded under FP7-SPACE.
- http://cordis.europa.eu/news/rcn/124662
- Project website: http://www.sr2s.eu/
- http://bit.ly/1LcVo4t

SWIRLING SECRETS IN STARS' PLANET-FORMING DISCS

Newborn stars are surrounded by protoplanetary disks, swirling plasmas that can constitute the core of a developing solar system. EU-funded scientists have studied the disordered movement of the constituent gases to get a grasp of how they make this transformation.

By better understanding the nature of gases, scientists hope to learn more about how particles interact with each other and coagulate to ultimately form planets. The challenge is to develop correct models for the structure of the discs, describing how density and temperature change with distance from the star.

Assumptions must also be made as to the strength of the magnetic field that is present and the ionisation structure of the disc. Finding where the temperature might not be high enough to remove electrons from atoms and molecules is of importance in determining where turbulence will be more vigorous.

The challenge addressed within the EU-funded project HALLDISCS (Hall dominated turbulence in protoplanetary discs) was related to a technical issue regarding 'magneto-hydrodynamics' (MHD) simulations. The existing algorithms were not able to capture the nature of the Hall effect.

In plasmas composed of neutral molecules, ions and electrons, the velocity difference between positively and negatively charged species gives rise to the Hall effect. In addition, Ohmic dissipation is caused by collisions between electrons and neutrals, and ambipolar diffusion by collisions between ions and neutrals.

The HALLDISCS team performed 3D simulations that included all three non-ideal MHD effects to investigate the role of the Hall effect on disc gas dynamics. The Hall effect revived 'dead' zones by producing a magnetic field together with a considerable stress throughout the disc mid-plane.

Specifically, the plasma flow in the mid-plane was found to be generally laminar, suggesting that the rate at which dust settles is high. These results call into question contemporary models of layered accretion and demonstrate that the Hall effect must be considered to obtain even qualitatively correct results.

By comparing observations with the theoretical predictions, HALLDISCS scientists hope to be able to verify their understanding of how disc accretion works in the next few years.

HALLDISCS
★ Coordinated by CNRS in France.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175196


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PATHWAY TO THE SQUARE KILOMETRE ARRAY

The Square Kilometre Array (SKA), with far superior sensitivity and observing speed than all current facilities, is the largest radio telescope ever designed. EU-funded scientists have carried out much of the policy work currently underway for its construction, which is expected to begin in 2018.

To achieve both high sensitivity and high-resolution images of the radio sky, around 3 000 individual radio dishes and other receivers will be arranged like a spiral galaxy. Most of the antennas will be concentrated in an inner core and the rest positioned in groups along spiral arms. This configuration will cover several thousand kilometres in diameter.

When fully operational and running, the SKA will be 50 times more sensitive than any other radio telescope. This power will be used to hunt for gravitational waves, namely ripples in space-time predicted by Einstein's general theory of relativity. It will probe the magnetic field that exists between stars and explore the Universe's most fundamental open questions.

The technical framework assembling the best options for its construction was initially prepared in the project PREPSKA. This project GO-SKA (GO-SKA: A proposal for coordinating & supporting policy development of the global organisation of the Square Kilometre Array) followed up on the procurement processes.

GO-SKA was initiated by funding agencies in Germany, Italy, the Netherlands and the United Kingdom. The four project partners joined their efforts to help with establishment of a new legal entity. Specifically, they worked together with the SKA's Strategy and Business Development Committee to establish the SKA organisation in December 2011.

"The SKA will be 50 times more sensitive than any other radio telescope."

In addition, a roadmap was prepared with major decisions needed to be made so that the SKA can progress to the pre-construction phase. These decisions include approval of funding and, more important, selection of the site where it will be built. Containing a

detailed timeline, the roadmap should serve as a guide to the next phase.

In May 2012, the participating nations divided the SKA project between Africa and Australia, where precursor telescopes had already been built and could be integrated into the SKA radio telescope itself. Its low-frequency component will be hosted in western Australia and the mid- and high-frequency components in southern Africa, where it will be merged with Meer KAT, the former Karoo Array Telescope.

Project partners held a series of events to raise public awareness of the socioeconomic benefits of the SKA. When the SKA radio telescope is completed, both Africa and Australia will actively participate in a cutting-edge science endeavour to gain insights into the formation of the first stars and galaxies after the Big Bang, the history of neutral hydrogen and the nature of gravity.

GO-SKA

★ Coordinated by NWO in the Netherlands.
★ Funded under FP7-INFRASTRUCTURES.
★ http://cordis.europa.eu/result/rcn/150546
★ Project website: http://goska.skatelescope.org/

WHAT REGULATES THE GROWTH OF GALAXIES?

Galaxies, like anything else in our Universe, come in different sizes. With the support of EU funding, theorists and observers joined their efforts to pin down how the surrounding environment affects their growth.

Popular theories suggest that galaxies grow in clusters — large collections of galaxies bound together by gravity. Their interactions in this dense environment affect how each galaxy grows, forms stars and takes shape. In particular, collisions are key in triggering star formation and altering the morphology of the galaxies.

Each galaxy's fate is also partially determined by how massive it was to begin with and when it was formed. The EU-funded project PHIZ-EV (The growth of galaxies) was initiated to find out which of these factors dominated the galaxy's subsequent evolution.

The PHIZ-EV astronomers used a massive data set of more than 250 000 distant galaxies from the 'Cosmic assembly near-infrared deep extragalactic legacy survey' (CANDELS). Combining optical and infrared imaging from the Hubble space telescope, this survey documents the evolution of galaxies at a redshift larger than 1.5.

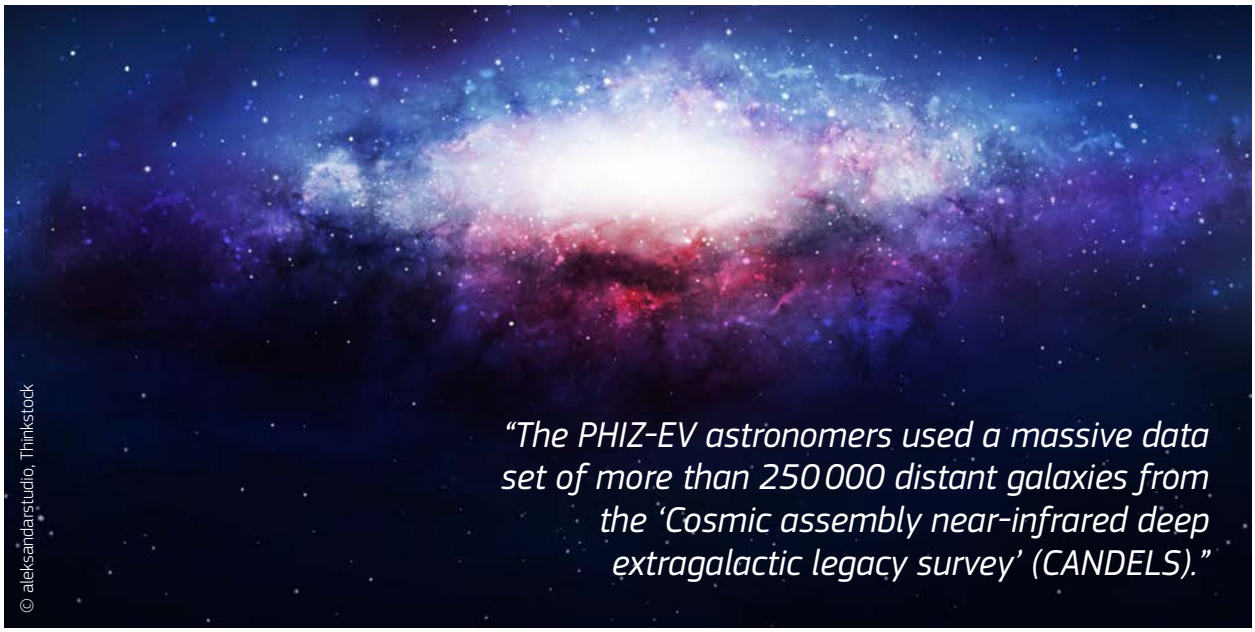
CANDELS includes galaxies from when our Universe was about 3 billion years old. By seeing how the average stellar mass of these galaxies changes with time, the PHIZ-EV team could quantify how galaxies evolved as a function of their environment.

Having ascertained the galaxies' composition by comparing the observations with hydrodynamic simulations, the scientists built up a picture of galaxy evolution. Moreover, a new method was developed to identify signatures of recent mergers from images of distant galaxies and to link these with the timescales of star formation.

By improving on previous analyses, the PHIZ-EV project has opened entirely new windows on the physical processes responsible for galaxy growth. Altogether, the findings will help astronomers determine the role of galaxy mergers in forming the galaxies we see today.

PHIZ-EV

★ Coordinated by the University Court of the University of St Andrews in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175065



EVENTS

MAY
02▸04

Granada, SPAIN

WORKSHOP

MIND PROJECT WORKSHOP AND ANNUAL MEETING

The project will host an open-for-all workshop on 2 May that will aim at providing a forum for discussion of scientific and technical MIND project results, preparing for periodical reporting and planning for the future project programme. The project workshops contribute to integration within the project and communication with a broader interested community.

Topics to be covered include:

- molecular protocols, metagenomics and bio-informatic pipelines;
- research design working with buffers and back-fill — incubation systems, densities and swelling properties, detection of microbial activity and diversity.

The project's inaugural annual meeting will begin in the morning of 3 May and continue until lunchtime on 4 May.

For further information, please visit:
http://www.mind15.eu/okategoriserade/project-annual-meeting/

MAY
10▸11

Barcelona, SPAIN

WORKSHOP

SPECS/PREFACE WORKSHOP

The EU-funded projects SPECS and PREFACE will jointly host a workshop on 'Initial Shock, Drift, and Bias Adjustment in Climate Prediction' in Barcelona, Spain, from 10 to 11 May 2016.

The aim of the workshop is to seek common ground on current strategies in understanding the physical processes behind the initial shock and drift in dynamic climate prediction for all time scales, and to formulate recommendations that will guide future international research activities. The question of bias adjustment will be considered as a necessary tool for engaging with the users of the resulting climate information.

The discussions will be based on the activities already taking place in the SPECS and PREFACE European FP7 projects and contribute to the activities of the initial shock and drift project promoted by the Working Group on Seasonal-to-Interannual Prediction (WGSIP) of the World Climate Research Programme (WCRP).

For further information, please visit:
http://www.bsc.es/earth-sciences/specsprefacewcrp-workshop-initial-shock-drift-and-bias-adjustment-climate-prediction

MAY
25▸27

Amsterdam, THE NETHERLANDS

CONFERENCE

PASTEUR4OA FINAL CONFERENCE

The EU-funded PASTEUR4OA project will be hosting its final conference in Amsterdam, the Netherlands, from 17 to 18 May 2016.

The PASTEUR4OA (Open Access Policy Alignment Strategies for European Union Research) project has been working to develop and reinforce 'open access' (OA) strategies across Europe, to engage policy makers and to establish a network (Knowledge Net) aimed at promoting OA alignment across multiple countries.

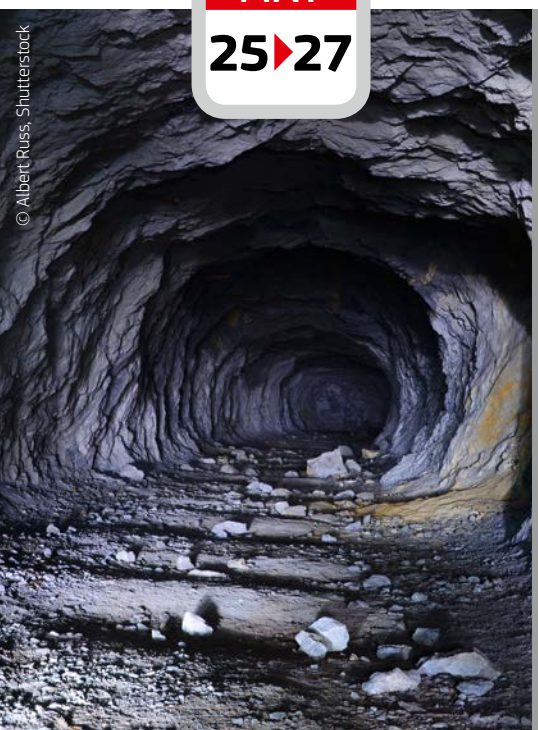
The conference will provide the perfect venue for discussing the overall OA landscape and the achievements of the project, along with experts, funders, research institutions and policy makers from across Europe.

Discussions held during the conference will be especially timely as they coincide with the Dutch Presidency of the European Union. OA has been named as a priority during the Dutch Presidency and this conference is an event officially associated with the Dutch Presidency.

For further information, please visit:
http://www.pasteur4oa.eu/final-conference

EVENTS
For more forthcoming events:
http://cordis.europa.eu/events

MAY
25▸27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TURKU, Finland

SEMINAR

THE EU-FUNDED DOPAS PROJECT WILL HOLD ITS 2016 ANNUAL SEMINAR IN TURKU, FINLAND, FROM 25 TO 27 MAY 2016.

The international seminar DOPAS 2016 will focus on state-of-the-art plugs and seals. This will include discussion of the lessons learned from full-scale demonstrations undertaken as part of the European Commission DOPAS Project between 2012 and 2016. The seminar will highlight the design basis of plugs and seals, reference designs including rock excavation and materials development, and strategies to demonstrate the compliance of the reference designs to the design basis and how full-scale experiments can support implementation.

The seminar will seek to develop a broad overview of plugs and seals. To this end, the seminar encourages participation from anyone undertaking research and development on plugs and seals in all types of repository programmes, as well as regulators and other stakeholders. In addition, the seminar would welcome perspectives from other industries, such as mining, hazardous waste disposal, CO_2 sequestration and underground storage where final closure is needed.

For further information, please visit:
http://www.posiva.fi/en/dopas/dopas_2016_seminar

ZZ-AC-16-003-EN-N

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