



European
Commission

research[★]eu

RESULTS MAGAZINE

N°41
APRIL 2015

SPECIAL FEATURE

HIP RESEARCH FOR THE YOUNG



SOCIAL SCIENCES AND HUMANITIES
**THE PSYCHOLOGY BEHIND
GREEN TAX EFFICIENCY**

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Published by

The Community Research and Development Information Service (CORDIS) managed by the Publications Office of the European Union
2, rue Mercier
2985 Luxembourg
LUXEMBOURG
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The *research*eu results magazine* is published by the Community Research and Development Information Service (CORDIS) and managed by the Publications Office of the European Union. Content is prepared using several sources, including CORDIS, the Research Information Centre, ERC, as well as original material collected specifically for this publication.

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ISSN 1831-9947 (printed version)

ISSN 1977-4028 (PDF, EPUB)

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EDITORIAL

by the editorial team

SCIENCE BY AND FOR THE YOUNG

If science and youth had just one thing in common, it would most likely come down to how their evolution can impact the future of humanity. But the two are also closely intertwined: science needs young people, and the other way around.

The emphasis that the EU and its Member States have been putting on the promotion of science among young people over the few past years is probably the most striking evidence of this

‘Numerous FP7 initiatives have focused on youth-related diseases, while social and economic trends affecting youngsters have been subjected to research for the past 20 years.’

symbiotic relationship. Some EU countries are facing an all-time high in youth unemployment, and there is a growing trend that sees more and more youngsters turning their back on scientific studies. It therefore comes as no surprise that helping young researchers start a successful career in Europe and making science courses more appealing are part of the EU's checklist to maintain the EU's competitiveness and capacity to innovate. Relevant projects have been undertaken in both FP7 and Horizon 2020 programmes, with the most recent one consisting of a ‘call for making science and careers attractive for young people’ with a total budget of EUR 13.15 billion.

Less documented but carrying a similar weight are scientific projects focusing on the needs, problems and day-to-day reality of young people. Numerous FP7 initiatives have been dedicated to youth-related diseases, while social and economic trends

affecting youngsters have been subjected to research for the past 20 years. Such projects covered a large spectrum of topics, from reducing exclusion to tackling unemployment and integration challenges.

This edition of the *research*eu results magazine* focuses on similar initiatives. It includes 11 articles on projects which were recently or will very soon be completed, among which are four interviews on the issues of racism among young people using social media, a new method to make neuroblastoma treatment more effective, remote tools to help autistic children from their home, and a unique concept to turn children stories and other texts into realistic virtual worlds.

These ‘specials’ are followed by our usual seven sections on biology and medicine, social sciences and humanities, energy and transport, the environment, IT and telecommunications, industrial technologies and space. The magazine closes with a list of upcoming events.

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



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Road safety:
towards zero
fatalities?

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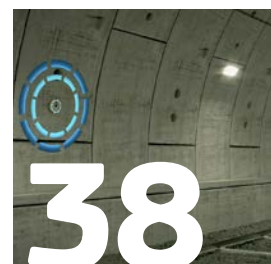
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SPECIAL FEATURE

HIP RESEARCH
FOR THE
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INTERVIEW

NEW DRUG CONTAINERS HELP
DECREASE RESISTANCE TO
NEUROBLASTOMA TREATMENT

Drug resistance is a growing concern for society, affecting many treatments ranging from antibiotics to cancer drugs. Researchers have set out to tackle this phenomenon in children diagnosed with neuroblastoma, a cancer affecting the peripheral nervous system.

As the most common form of solid tumor amongst children, neuroblastoma is responsible for 15% of deaths in under 15-year-olds, with only 30% of stage 4 (metastatic) patients surviving the disease.

These mitigated results can easily be explained. Fighting neuroblastoma involves complex treatments whose results are threatened by rapidly developing drug resistance. It is generally considered that this resistance is due to the biological properties of the affected cells, but what if inadequate drug penetration could also be held responsible?

This is the lead followed by Drs Jaume Mora and Angel Montero-Carcaboso from Hospital Sant Joan de Déu under the EU-backed NEUROBLASTOMA CHERO (Chemotherapy of neuroblastoma) Marie-Curie action. The project, which ran for four years and was completed last month, aimed to design pharmacological treatments capable

of circumventing some of the known drug resistance mechanisms, while more efficiently penetrating the neuroblastoma tumour cells.

In spite of facing some unexpected difficulties, the team managed to develop a new drug delivery system made of biocompatible polymer nanofibres and container anticancer agents. They agreed to unveil the project results and discuss future research in this exclusive interview with the *research*eu results magazine*.

★ **What are the main objectives of this project?**

Dr Angel Montero-Carcaboso: Our proposal addressed several questions related to the pharmacology of neuroblastoma, an aggressive paediatric solid tumour. The first question was whether anticancer drug distribution is restricted to more aggressive neuroblastomas. Thus, we designed a combined microdialysis-tumour homogenate technique to characterise intra-tumour

drug distribution in 'Patient-derived xenografts' (PDX) created at Hospital Sant Joan de Déu (HSJD) in Barcelona.

We also wanted to understand whether recurring tumours after clinical treatments evolve towards what we call 'drug-impenetrable phenotype'. To address this question, we established PDX from the same patients at different stages of treatment (diagnosis and relapse) and applied the techniques mentioned. The third question behind our work was related to the design of new drug-delivery systems (DDS) to enhance drug penetration in highly chemoresistant tumours.

Dr Jaume Mora: Most importantly, the strategic goal of our proposal was to establish a translational research laboratory in paediatric solid tumours at Hospital Sant Joan de Déu, Barcelona, the host institution, focusing on the improvement of therapy for children with solid tumours by means of preclinical studies.



★ **What are the main reasons behind the poor results of current treatments?**

JM: Developmental cancers, otherwise known as children's tumours, are generally highly sensitive to conventional chemotherapeutic agents. However, 20-30% of cases remain incurable. These include subtypes of cancers like central nervous system tumours, relapsed cases or metastatic cases. Acquisition of drug resistance is primarily responsible for treatment failure in these patients, because many tumours respond well to initial chemotherapy but eventually progress towards an intractable disease.

Several factors are thought to contribute to the emergence of multidrug resistance in neuroblastoma. Loss of function of the gatekeeper protein p53 has been shown to confer a broad multidrug-resistant phenotype in neuroblastoma cells. Accordingly, increased frequencies of mutations in the TP53 gene as well as aberrations that result in inappropriately increased activity of the p53 inhibitor MDM2 have been observed in neuroblastoma cell lines that were established from patients in relapse. Elevated expression of drug efflux pumps has been implicated as a second group of mechanisms by which neuroblastoma cells evade therapeutic intervention. The combination of both factors may lead to the inadequate penetration of chemotherapy to the solid tumour cells, what we call the 'drug-impenetrable' phenotype. That functional barrier is what we set out to measure.

★ **Did you find a solution to ensure a better penetration of drugs into tumorous cells? How so?**

AMC: Yes. We have developed a local DDS consisting of a tissue made of biocompatible polymer nanofibres containing pure drug particles of a potent anticancer agent. After the nanofibres was deposited on the surgical bed following tumour resection surgery, we found potentially active drug concentrations in the surgical bed for up to one week. As a consequence of increasing local drug distribution, our DDS improves control of tumour recurrences in the resected area. We observed promising activity in preclinical models of paediatric solid tumours such as neuroblastoma, Ewing sarcoma and rhabdomyosarcoma. The drug released from the DDS achieves minimal concentrations in blood, as compared to the concentrations achieved after systemic administration of the drug.

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

AMC: As with every new project in a new host institution, the project evolved to take advantage of the strengths provided by the host. Also, we found that several of the initial objectives of the project were not feasible due to technical reasons (for instance, the model drug did not encapsulate in micelles as initially planned), practical reasons (no providers for specific drugs), or experimental reasons (lack of

activity of the initially proposed drugs). We overcame all the difficulties and improved the project as compared to its original version.

★ **So now that the project is coming to an end, would you qualify it as a success?**

JM: Yes. The project produced three patent applications related to the DDS. We published one manuscript and two more are in preparation. The project provided the basis for many other projects currently ongoing in the lab. We set up a very important resource at the host institution and now have six researchers working under the research line 'Preclinical Therapeutics and Drug Delivery Research Program', established as a direct result of this Marie Curie action.

"There is a plan at the host institution to bring the DDS technology to clinical trials in the medium term."

★ **When do you expect your research to start benefitting patients?**

AMC: There is a plan at the host institution to bring the DDS technology to clinical trials in the medium term (three years). We are running other projects in parallel that will lead to three clinical trials at the host institution within the next two years.

★ **Do you have any follow-up plans after the end of the project?**

JM: We are currently developing a new targeted nanomedicine for neuroblastoma. Our research is always guided by the feedback of the clinical team and patient advocates. Together, we identify the unmet medical needs that we should focus on in future translational projects.



NEUROBLASTOMA CHEMO

★ Coordinated by Sant Joan de Déu Research Foundation in Spain.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/project/rcn/98514>

GROWING UP IN THE SHADOW OF INTOLERANCE



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Despite the recent rise of radical, extreme or populist movements in Europe, young Europeans still accept democracy and reject violence, an EU-backed project has found. However, many feel that the political establishment does not represent them, leading them to consider alternative politics. Politicians must start listening more to young people to engage them fully in the democratic process, the researchers advise.

For young Europeans today, Fascism, Nazism, Stalinism and even the Cold War are distant events of which they have no personal memories. Still, as has been shown by the recent success of radical, extreme or populist movements in parts of Europe, the past may still be casting a shadow across the contemporary political landscape and presaging an uncomfortable political future.

Central to shaping that future are the political attitudes and behaviour of young people. The EU-funded MYPLACE (Memory, Youth, Political Legacy And Civic Engagement) project is investigating young people's political, social and civic participation, and the influence of Europe's political legacies on their present attitudes and actions. It is also assessing their future receptivity to radical political agendas.

MYPLACE asks whether 'difficult pasts' and 'depressing presents' lead to 'radical futures', says project coordinator Hilary Pilkington from the University of Manchester in the UK.

'Youth civic and political engagement must be understood as firmly rooted in its structural — including the historical and cultural — context while recognising that this changes across time and space, and that young people themselves are active agents of that change,' explains Pilkington.

MYPLACE is carrying out the research in 14 countries across Europe — from Georgia in the east to Portugal in the west, and from Greece in the south to Finland in the north.

The project is based on the assumption that Europe's radical political and philosophical traditions have much in common and their popularity is of a cyclical nature. The project takes a case-study approach based on in-depth research in two contrasting locations in each participating country. One

exception is Germany, where the researchers examined four locations in order to reflect the different political legacies when the east and west of the country were divided during the Cold War.

The advantage of this approach, argues Gary Pollock, MYPLACE survey team's co-lead, is that it provides the deep local context needed to understand the motivations for engagement and activism among young people.

'A careful selection of contrasting research locations allows us to better represent specific intra-national experiences than to represent each country in an averaged way,' he notes.

Understanding (dis)engagement

MYPLACE's research involves surveys, interviews, focus groups and ethnographic studies — which allows the team to build up a more complete understanding of how politically engaged young Europeans feel and how their attitudes affect their civic, political and social participation.

'MYPLACE replaces the routine, and often abstract, iteration of the reasons for young people's "disengagement" from politics with an empirically rich mapping of their understanding of the civic and political space that they inhabit and why they may choose to absent themselves from formal politics,' explains Pilkington.

A unique aspect of the project is its study of contemporary attitudes on political and civic engagement in the context of past political legacies. Central to this has been gaining an understanding of how the past is interpreted through the construction and transmission of historical memory.



The findings of this part of the project, explains Anton Popov, co-lead of this area of the research, 'demonstrate how internalisation of political heritage via mnemonic socialisation within families is conditioned by both the national political agenda and the socio-economic situation experienced across Europe.'

Another unique feature of MYPLACE has been its integration of the measurement of young people's political attitudes and behaviour. This was done via locally representative surveys of 16-25-year-olds.

The project team gave a deeper interpretation of these aspects through follow-up interviews with selected survey participants. They also conducted extended ethnographic case studies with more than 40 activist groups.

This holistic approach has thrown up results that challenge claims about the political 'apathy' of young Europeans. MYPLACE's surveys indicate that 42% say they are in fact 'interested' in politics.

'Employment, housing and the environment are the three issues that are of greatest interest for these young people,' observes Pollock. 'The European Union, immigration and rights for lesbian, gay, bisexual and transgender people, in contrast, scored lowest in terms of the level of political interest.'

The lure of alternative politics

Mick Carpenter, co-lead of the policy aspect of the project, says the concern is that political interest does not translate into comparable levels of engagement with formal politics and the political system.

He adds: 'This is mainly due to the low level of trust and high level of cynicism that exists in most of the MYPLACE countries towards politics, politicians and the political system.'

In terms of trust, young Europeans tend to invest relatively little in the political system and far more in the courts, the military and civil society organisations, such as Greenpeace and Amnesty International, MYPLACE found.

Although this is not true for all locations and countries, it may explain why many young Europeans are more likely to be involved in 'Non-governmental organisations' (NGOs) and other forms of social activism than in formal politics.

The survey data, which also measured levels of cynicism, show that young people feel remote from what they perceive as the political elite across Europe.

'Absolute levels of cynicism were high and are a clear indication of the general strength of views across all locations,' concludes Pollock. This was reflected by a project survey, which found that 60% of young respondents agreed with the statement that 'politicians are corrupt' while 69% believed that 'the rich have too much influence in politics'.

This should not lead to the hasty conclusion that young people are disconnected from politics, or apathetic, and therefore disinclined to engage in it, says Pilkington.

MYPLACE's multidisciplinary approach, Pilkington suggests, 'is able to reveal that, paradoxically, young people often say they are "disinterested" or fed up with politics but in a very engaged and passionate way.'

Moreover, while young people have been increasingly disinclined to engage in traditional political participation, they also continue to support the fundamental principles of

democracy and believe that the most effective way to influence politics is through traditional means.

'Voting in elections received the highest mean score for effectiveness of political action,' says Tina Zurabishvili, co-lead of the MYPLACE survey team.

While the project is still ongoing until May 2015 and final conclusions have not been reached, Pilkington suggests that one way of interpreting this paradox is to view young people as being engaged in a disavowal of politics and the political.

This could be interpreted as a demonstrative dismissal of what is imagined as 'the political' whilst engaging, on their own terms, with ways of changing the world that they choose not to call 'politics', she explains.

Listen to the youth

The project also found that young Europeans in general are opposed to political extremism and the use of violence to achieve political aims. Still, there is little room for complacency, since young people, despite their generally liberal attitudes towards social issues, often possess a hostility towards immigrants and minorities not dissimilar to nationalist or populist radical parties, says Pilkington.

Pilkington's own experience of conducting follow-up interviews with young people — including members of the radical English Defence League — revealed

that anti-immigrant or racist statements are often made more routinely or 'unreflexively' by ordinary youth rather than by young activists widely represented as far right.

MYPLACE has generated a number of recommendations for policymakers and practitioners designed to boost youth participation in the democratic process.

The project recommends that they should more effectively reach out to young people and reduce the potential for social unrest. Central here is the urgent need for diverse policies that would improve the economic situation of European youth who have been affected disproportionately by the recent economic crises. Treating young people as active citizens capable of social change is also essential.

'Boosting participation requires tackling the attitudes of politicians and the establishment, as well as empowering young people, through citizenship training and strengthening youth NGOs, to take an active role in voicing their political concerns,' emphasises Carpenter.

'If we do not listen to youth, their only option will be to shout louder and say things that we would prefer not to hear,' argues Pilkington.

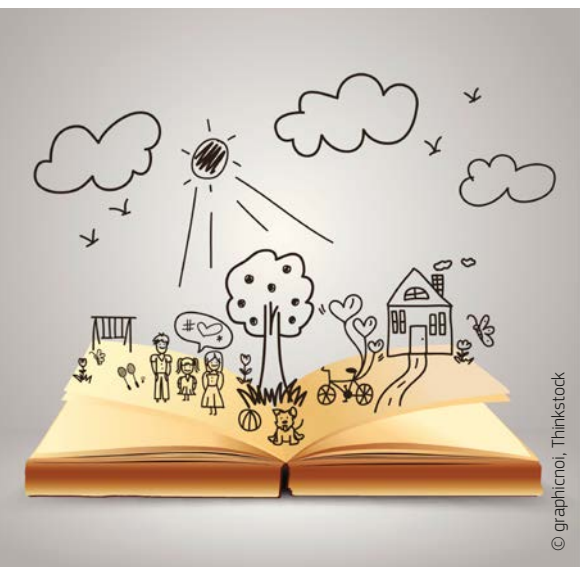
"Young Europeans tend to invest relatively little in the political system and far more in the courts, the military and civil society organisations."

MYPLACE

- ★ Coordinated by the University of Manchester in the United Kingdom.
- ★ Funded under FP7-SSH.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33756
- ★ Project website: <http://www.fp7-myplace.eu/>
- ★  <http://bit.ly/1BUdS4J>

FROM TEXT TO VIRTUAL WORLD: THE MUSE PROMISE

Some readers would tell you that the best texts or books are those which can provide the most immersive experience. The MUSE project is taking this idea to a whole other level by developing a translation system capable of converting texts into 3D virtual worlds.



As exciting as they can be, the facts discussed in, let's say, history books are not always easy to grasp especially for young children, and reading through hundreds of pages of heavy text can be wearisome to say the least. Of course the tremendous success of history-based video game franchises shows that the interest is there, but it also demonstrates that interactivity can sometimes be a much better way to convey stories in an appealing and memorable manner.

To this day, however, the path from book to video game is often long and expensive. But what if, in the near future, computers could understand a text and convert it automatically into characters, situations, actions and objects depicted in a 3D virtual world, turning passive readers into active participants in a story? This is the exciting promise made by the EU-funded MUSE (Machine Understanding for interactive StoryTElling) project — which aims to bring texts to life by developing an innovative text-to-virtual-world translation system.

Over the past two-and-a-half years, the team has been evaluating the technology in two scenarios: children's stories and patient education materials. The project website notably

features a demonstration video of a conversion from a patient manual to a video game where the reader can walk around a hospital, get familiar with the admission process and better understand the treatments he will receive.

This is the first major step towards commercialisation of such a groundbreaking technology. MUSE could have a tremendous impact on sectors such as the video game industry which could take advantage of its natural language processing method to simplify their development processes, or schools which could use it to make their teaching programmes more effective and impactful.

Prof. Dr Marie-Francine Moens from KU Leuven, who coordinates the project, sheds light on the way the technology will operate, as well as the team's plans for bringing it closer to market.

★ **How did you come up with the MUSE concept?**

Prof. Dr Marie-Francine Moens: I already had the idea for a number of years that people or students in a learning environment — when accessing information — should benefit from a more lively experience. Hence the idea of automatically turning text into actions and situations taking place in a virtual world. In such a world, the user could eventually become part of the story. For instance, instead of reading or studying a rather boring historical text, the student could become one of the actors in a scene in which Napoleon was signing a treaty. Such an environment would stimulate the understanding of the text and the memorisation of its content. The MUSE project does not go that far, but it lays the foundations for such a technology.

★ **How would the conversion work exactly?**

The idea is to translate actions, actors and objects recognised in a text

into visuals. We have developed advanced natural language processing components for the semantic processing of the texts. They include the recognition of semantic roles in sentences (i.e. 'who' 'does what' 'where', 'when' and 'how'), spatial relations between objects (where an object or person is located) and chronology of events.

Here we follow standard linguistic semantic annotations, as they have been well studied in the past and provide annotated datasets for training our recognition algorithms. Because the recognitions are often uncertain and in many cases background information is needed to understand natural language utterances (which is left implicit in the text), we have developed a Bayesian network framework in order to find the most probable interpretation of a sentence in light of the evidence obtained from the text itself and from background knowledge.

★ **Which core markets are you targeting with this technology?**

We primarily target the game industry and publishers who provide e-learning tools. When creating virtual worlds, these industries currently rely heavily on hand-crafted knowledge. Automatically translating natural language utterances into instructions in a graphical world would deal with this bottleneck.

★ **In the case of children's stories, what are the benefits of your technology**

The MUSE tool can help as the child learns how to read. The visuals could be adapted to the reading level of the child. The tool can help children learn how to make inferences when reading and ultimately better understand a text. In addition it could be an assisting tool in text understanding, memorisation and crosslinking (for instance when studying a text about science or biology). Right now, we are evaluating the use of the visualisations with children.



© Marie-Francine Moens

PROF. DR MARIE-FRANCINE MOENS

★ **The project will be ending soon. Are you happy with the results so far?**

Overall, I am happy with the outcomes. I am especially pleased with the results of our natural language

understanding research. We have managed to advance the state-of-the-art in this challenging field. Several publications are in the pipeline. Natural language understanding is very important for a huge amount of applications, but still needs fundamental research especially with regards to the automatic acquisition of perceptual background or world knowledge.

MUSE has given us valuable insights, which will translate into follow-up research. A partner who is knowledgeable about programming languages specifically designed to steer the visualizations in computer graphics could have strengthened the MUSE consortium, because the goal of MUSE is to map natural language into representation standards for the computer graphics world, but such expertise was hard to find.

★ **When do you expect the MUSE technology to be commercialised? Have you been in touch with potential partners already?**

The language technologies will be used in a Belgian spin-off named SmartSpoken, which is currently being set up. There are already talks with

the Belgian gaming company Fishing Cactus.

★ **Do you have any follow-up plans after the end of the project?**

Yes, a very interesting novel field of research in natural language understanding looks at multimodal representation learning (based on neural network technology, vector models, probabilistic graphical models, etc.) in which textual and visual data help in acquiring and capturing background and world knowledge. This technology is beneficial for both natural language understanding and computer vision.

We have applied for several research projects on this topic at both national and European level, and we hope that they will be granted support.

MUSE

★ Coordinated by KU Leuven Catholic University of Leuven in Belgium.

★ Funded under FP7-ICT.

★ <http://cordis.europa.eu/project/rcn/104176>

★ Project website: <http://www.muse-project.eu/>

HOW DO INFANTS PERCEIVE COMMUNICATION?

When communicating, humans offer information as well as related intent. An EU-funded research project has investigated human communication from the perspective of infants.

The project COMINTENT (Information transmission in language: Do infants perceive communicative intent?) explored whether infants realise not only that speakers offer a message, but that there is also a purpose behind this transmission of information. Specifically, the study examined if, when and how infants begin to recognise verbal communication as a purposeful act. To this end, research involved both monolingual and bilingual infants. This population varied in age and numbered around 300, while the adult subjects numbered some 700.

Researchers investigated whether, and under what conditions, infants expect others to share a language. Another line of inquiry focused on the inferences infants draw when a communicative code is shared.

Additionally, research examined how infants and adults learn about important carriers of communicative load in language. This load includes words and how they are organised in terms of syntax. Further, the team studied low-level cues that observers use to track and remember individuals who are socially relevant to them.

COMINTENT worked on creating a software package that analyses eye tracking data, and developed various computational models of certain aspects related to language acquisition. Although the project funding period has ended, results on collected data are still being analysed. The

project nevertheless intends to publish the data and models advanced in at least 10 peer-reviewed papers.

The project's experiments are among the first targeting perception of both speaker and listener intentions in verbal behaviour as regards young infants. They explore an emerging and very important element of linguistic communication — one that could well be unique in the animal kingdom.

COMINTENT

★ Coordinated by Pompeu Fabra University in Spain.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/result/rcn/155355>



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ENCOURAGING EUROPE'S FUTURE SCIENTISTS

The European Contest for Young Scientists (EUCYS), celebrating its 25th anniversary, is still leading the way in fostering young talent and increasing awareness of its significance.



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Getting young people excited about science can be a challenge, however this is important for future research and innovation. EUCYS aims to increase youth interest in science both as a subject and as a prospective future career.

Set up in 1989, EUCYS is an annual contest showcasing the best of European students' scientific projects. Besides competing with their top contemporaries, participating students have the opportunity to network with others who share their interests, including prominent European scientists.

Held in Prague for the first time, the EU-funded EUCYS 2013 (European Union Contest for Young Scientists 2013) project hosted 124 contestants from 37 countries. Eighty-three projects competed to win the EUCYS prizes. The range of topics included biology, chemistry, engineering and environmental science, to name a few.

In addition to celebrating the 25th anniversary of the Contest, the organisers aimed to encourage young scientists

to pursue their interests and foster future interest in research in leading European institutes. Communication with the general public was a key feature of the event and was exhibited through various means such as social media, a contest catalogue and outdoor advertising, as well as a hands-on science exhibition attended by over 3 000 members of the public.

EUCYS 2013

- ★ Coordinated by the Academy of Sciences of the Czech Republic.
- ★ Funded under FP7-SIS.
- ★ <http://cordis.europa.eu/result/rcn/151719>
- ★ Project website: <http://eucys2013.ssc.avcr.cz/home/index.html>
- ★ <http://bit.ly/1aMW1AA>

DESIGN REVOLUTION IN THE CLASSROOM

A little wiggle room, an armrest at the right height, and room to stretch your feet out are all priorities in comfortable seating. A relaxed skeletal position can make a big difference in any audience's attention span. A recent EU project worked on acquiring and transferring knowledge for the development of new products for task furniture in education.

Imagine how much more a child learns when comfortably seated, free from tension, free to absorb knowledge. Designing and arranging an optimal learning environment connects the disciplines of industrial design, ergonomics, education, pedagogy and physiotherapy.

Between November 2010 and October 2014, the team in the EU-funded TFE (Task Furniture in Education) project inventoried existing school furniture and new products with the aim of acquiring and transferring knowledge for the development of new and appropriate school furniture.

While incorporating novel methodologies, the researchers assessed current furniture inventory, then measured it against physical and mental health standards. These standards, revised recently, incorporated the latest information in postural health. Sitting at a computer for hours a day, while studying and reading, can create unwanted neck and back tension. These types of issues along with others resulting from the constant use of modern day technology were taken into account.

An important aspect of the project was the bringing together of researchers who soon created academic bonds that look set to continue providing direction for future research studies. Building on these relationships, the consortium added to and spread the information collected about posture, space, learning and technology.

Dialogue between the researchers and the commercial industry can help improve educational environments, potentially on a global level. Keeping this in mind, the project sought to move forward with patents, copyrights and

commercial sales in partnerships with current stakeholders.

In the last year of the project, the team also ran a competition called 'Moving Education'. A total of 54 teams comprising 200 students from 10 countries entered the competition which challenged third-level students to come up with new ways of improving movement in second-level education. The teams focused on the four key areas of environment, pedagogy, media and community. The winning team from Carlow IT in Ireland was awarded a cheque for EUR 5 000 in June 2014. Overall, the judges were highly impressed with the calibre of entries. The panel noted, 'The winning entries all displayed a strong innovative agenda and approach, and we look forward to seeing them develop further through collaboration with the Moving Education research team and TFE project's academic and commercial partners.'

"An important aspect of the project was the bringing together of researchers who soon created academic bonds that look set to continue providing direction for future research studies."

TFE

- ★ Coordinated by the National College of Art and Design (NCAD) in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151412>



INTERVIEW

HOME-BASED TREATMENT OF AUTISM

Much can still be done to improve autism treatment besides finding a cure. The MICHELANGELO project, which ended in March, has developed a set of technologies for personalised, home-based behaviour monitoring and treatment of patients.

For a child suffering from autism, a treatment involving constant back and forth journeys between home and hospital can be difficult to cope with. But this also has many other shortcomings: it marginalises the potential role of parents in helping their children, doesn't reflect real life behaviours, is not intensive enough and fails to consider the specificities of each patient. Last but not least, it is a major financial burden for society as the number of children diagnosed with autism keeps increasing each year and a cure has yet to be discovered.

With all these problems in mind, the team in the EU-backed project MICHELANGELO (Patient-centric model for remote management, treatment and rehabilitation of autistic children) has spent the past 42 months working on home-based solutions for assessing and treating autism outside the clinical environment. The project has developed a range of pervasive sensor-based technologies to perform electro-cardiogram (ECG) measurements such as heart rate and respiratory sinus arrhythmia; camera-based systems to monitor observable behaviours while recording brain responses to natural environment stimuli; and algorithms allowing for the characterisation of stimulus-specific brainwave anomalies. These technologies will allow for personalised treatment and, just as importantly, will give parents the role of co-therapist, helping them to better understand their child and provide them with appropriate care.

Silvio Bonfiglio is the coordinator of the MICHELANGELO project, a role he was given due to his considerable experience in medical imaging, interactive solutions, user interfaces, mobile point of care and e-health. He highlights the main results of the project and expands on his plans for bringing it to patients by 2017.

★ **What are the main objectives of the project?**

Silvio Bonfiglio: We intend to move the treatment of children with 'Autistic spectrum disorders' (ASD) from the clinical setting to the 'more natural' home environment. There,



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newly-designed and non-obtrusive techniques will be used to ensure a timely assessment of the evolution of the disease as well as the prompt adaptation to and personalisation of the treatment.

These include the use and contribution to the advance of new technologies such as computer vision, unobtrusive and wearable 'electroencephalogram' (EEG) and 'electrocardiogram' (ECG) monitoring, eye-tracking, robotics, signal and image processing, etc.

Secondly, the project intends to contribute to research in ASD which is still in its infancy, and to open new opportunities in the field of 'personalized treatments'.

★ **What led you to do research in this area?**

According to recent studies, the prevalence of autism is increasing — in Europe, 1 case for every 86 children. This trend has a considerable social and economic impact, with heavy consequences affecting not only the patient but all family members. The average lifetime cost for a person with low functioning autism is estimated to range from EUR 5 to 6 million.

Our project builds upon the scientific acknowledgement that the efficiency of autism treatment could be greatly enhanced through the likes of early diagnosis and a timely and intensive educational programme carried out when the brain plasticity of the child is maximal, as well as the design and provision of personalised intervention protocols. Our technology is expected to contribute to the realization and success of this strategy.

★ **What are, according to you, the main benefits of a home-based intervention compared to in-lab experiments?**

By moving autism treatment from the clinical setting to home, the MICHELANGELO approach will help overcome the main weaknesses of current ASD management practices. We know for a fact: that the 'artificial context' of the lab-based environment generates results that do not reflect behaviours in real life; that the lack of intensiveness of the treatment — only 1 or 2 therapeutic sessions a week — limits beneficial effects; and that it entails a poor personalization of the intervention protocol.

To give you an example, a brain map obtained through an electroencephalogram (a quantitative QEEG

analysis) could give useful information. Unfortunately, the invasiveness of the currently-used systems (dense-array EEG systems) induces both systematic and non-systematic biases towards the experimental outcome, eluding the actual nature of the brain-wave behaviour and connectivity. MICHELANGELO minimises these biases and modulation effects by making the recording system pervasive in nature so that the patients becomes 'unaware' of its presence.

In the same way, a set of wearable and non-invasive sensors facilitates the monitoring of ECG parameters, thereby allowing the timely detection of problematic behavioural and emotional changes in the child (e.g. anxiety status, lack of engagement/attention, etc.). In that respect, the project's challenge was to achieve the best compromise between unobtrusiveness and measurement accuracy; it was obtained through novel algorithms for effective artefact suppression and intelligent solutions of data processing, fusion and feature extraction.

"Home-based intervention promises to improve the overall quality of care and certainly the quality of life of the patients and their families."

Furthermore, the home-based intervention promises to improve the overall quality of care and certainly the quality of life of the patients and their families (less need to travel to specialised centres, fewer lost working hours, etc.).

★ **How does the MICHELANGELO system work exactly?**

MICHELANGELO proposes an approach that includes five main steps: the characterisation of the autistic child in a controlled environment at the medical centre (the 'MICHELANGELO room'); the design of a patient-centric intervention protocol based on serious games; therapeutic intervention at home through physiological sensors; adaptation of the therapeutic intervention on the basis of gathered information (remote meetings and training); and a periodic assessment taking place at the hospital, with advanced lab examinations relying on new methods developed under the project.

★ **You claim that this method will be more cost-effective than in-lab experiments. How so?**

The MICHELANGELO approach combines intensiveness of the treatment — it is no longer limited to a few hours a week at the therapist's office or at the hospital — with cost effectiveness thanks to automation and minimal, seamless intervention by the doctor.

Another key benefit arises from early therapeutic interventions which also result in cost saving. As observed by the European Autism Information System, 'the later the intervention in the affected child's life, the greater the time and costs involved in providing healthcare and support services.'

Finally — as already mentioned — the home-based approach has clear benefits for the families by reducing the frequency of travelling to external specialised centres and the number of lost working hours.

MICHELANGELO also offers a tool for better productivity and support to the medical professionals during the therapeutic sessions with the child at the medical centre.

★ **What will be the role of parents in this setup?**

By transferring the therapeutic intervention from the hospital to the home, MICHELANGELO emphasises the role of the parents and educators and fosters the cooperation between them and the medical professionals. In the MICHELANGELO approach, they will act as 'co-therapists' and will participate in the care process.

★ **One idea that stands out on the project website is the observation that each child is unique. How does your system take this uniqueness into account?**

Indeed every child is 'unique with unique problems and needs'. So the treatment has to be tailored to this reality. As highlighted by some researchers, two people with the same age, gender, IQ, medication use and diagnosis may respond very differently to the same treatment.

Unfortunately there are still a lot of open questions pending since very little is known about how to individualise treatment protocols in ASD. MICHELANGELO proposes a quantitative way to assess the brain connectivity of a specific child while he/she is executing a task, to determine how the connectivity reacts to therapeutic



SILVIO BONFIGLIO

intervention, and to define whether a personalised therapy can produce structural changes in the brain by removing or reducing connectivity weaknesses.

Another key point is that different children in fact have different attitudes, needs and reactions to the treatment. By monitoring their psychophysical parameters it could be feasible to adapt the treatment as much as possible to their needs, maximise the efficiency and minimize the possible drawbacks of therapy.

In the same way, we demonstrated in MICHELANGELO how autistic children and typically developing children have significantly different features extracted by the ECG signal, in the Time- and Frequency-Domain, at baseline and during a specific task. We developed a wearable, unobtrusive ECG monitoring platform by making the approach minimally invasive. This solution supports the therapists in the diagnosis of ASD and provides a very reliable and objective way to assess the psychophysiological state of the child and customise the treatment as much as possible.

★ **When do you hope your technology to be made available to patients? Have you witnessed interest from potential partners yet?**

The exploratory study executed under the project in France and Italy provided the proof of concept of the approach developed in



MICHELANGELO. Now, more extended clinical studies will be needed to get a full medical validation, and at the same time further development activities have to be planned to refine and industrialise the solutions.

Considering these, we estimate that the market introduction of MICHELANGELO solutions can take place in two years from now, in 2017.

Therapists and clinicians from specialised medical centres have already shown interest in the novelty of both the approach as a whole and our ICT-based system, unanimously acknowledging their benefits in terms of efficiency, more accurate diagnosis and assessment, and quality of care. The parents of the children participating in the exploratory study were

equally interested, which is really positive.

MICHELANGELO

- ★ Coordinated by FIMI in Italy.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/100249>
- ★ Project website: <http://www.michelangelo-project.eu>

SETTING STANDARDS FOR SCIENCE EDUCATION

A year after the PATHWAY project concluded, its findings continue to attract attention. PATHWAY outcomes, including a methodology for designing and representing inquiry-based educational practices, were presented at the First European Responsible Research and Innovation Seminar on Science Education in September last year in Paris.

The seminar, organised within the ENGAGE project, aimed to create an opportunity for knowledge exchange among FP7 and H2020 projects and experts that contribute to connecting 'Responsible research and innovation' (RRI) and 'Inquiry based science education' (IBSE). As such, it was quite apt that the outcomes of the EU-funded project PATHWAY (The Pathway to Inquiry Based Science Teaching), which establish a 'pathway' towards a standard-based approach to science teaching and learning through enquiry, were presented to participants.

Apart from developing the methodology for IBSE practices, the PATHWAY team also defined features of learning environments that support teaching science by enquiry. Over the course of the three-year project, the team also reviewed successful training systems and methodologies in order to create a profile of the 'effective science teacher'. Other work included developing a framework for identifying IBSE best practices, and a host of supporting material which is available on the project website. One example is the booklet 'Best Practices of Inquiry-Based Science Education Methods and Activities'.

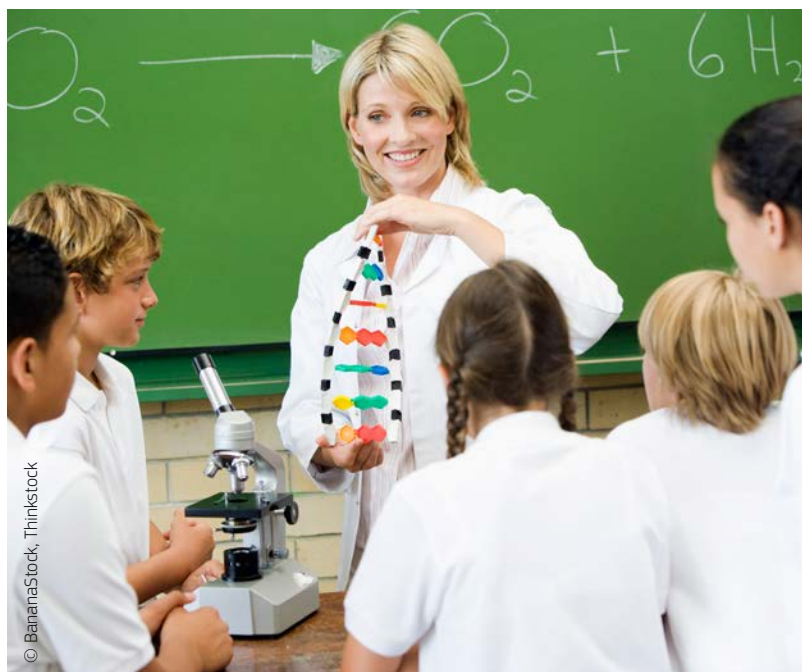
PATHWAY's efforts represent a targeted move away from a basic understanding of the nature of science (i.e. how science works), enabling students and teachers to become critical consumers of scientific knowledge. The project brought together experts in the field of science education and research, teachers, scientists, researchers, policy makers and curriculum developers. Its outcomes, which continue to spread, will enhance the public's ability to engage with important contemporary socio-scientific issues, imparting a deeper understanding of how science works.

PATHWAY

- ★ Coordinated the University of Bayreuth in Germany.
- ★ Funded under FP7-SIS.
- ★ <http://cordis.europa.eu/result/rcn/155326>
- ★ Project website: <http://www.pathway-project.eu/>
- ★ <https://www.youtube.com/watch?v=GabEt8je9yY>

"PATHWAY's efforts represent a targeted move away from a basic understanding of the nature of science (i.e. how science works), enabling students and teachers to become critical consumers of scientific knowledge."

Another key outcome of the project, which concluded in December 2013, is the booklet 'The Pathway to Inquiry Based Science Education'. Aimed at teachers, education professionals, researchers, student teachers and science learning experts, the booklet is available in eight languages on the project website. It provides an analytical summary of the best practices developed for IBSE. It also provides a framework for the design, development, organisation and sharing of resources, methods and tools for the effective promotion of teaching science by inquiry.



DIPPING INTO THE CULTURAL BARRIERS TO 'SOCIAL' MEDIA

With racism being a particularly worrying trend in recent times, observing youth's relationship with multiculturalism is probably as close as experts can get to crystal ball predictions about where racism is heading. And what better way to do that than to focus on the communication channels they are most fond of?

Young people are known to be the primary target of major social networks such as Facebook, Twitter and YouTube, where they can easily voice their opinions to friends and followers. The more they do, the closer they get to the much-envied status of social media influencer. What is less documented, however, is that a closer look at who follows who can actually reveal valuable information about how cultural differences are perceived among digitally-active youngsters.

This observation is what led Dr Koen Leurs to move from the Netherlands to London, a city well known for its social media appetite. For the past two years, and with support from the FP7 Marie Curie project UPLOAD (Urban Politics of London Youngsters Analyzed Digitally), Dr Leurs has been interviewing 84 Londoners from 12 to 18 years to generate valuable data about how the social media generation deals with cultural differences.

★ What are the main objectives of this project?

Dr. Koen Leurs: UPLOAD seeks to understand how young Londoners engage with cultural diversity using social media such as Facebook, Twitter and YouTube. More specifically, the main aim was to investigate how young Londoners (aged 12-18 years) digitally negotiate living together with racially and religiously different people. Developing a comparative approach together with Dr Myria Georgiou, I conducted fieldwork in three London boroughs — Haringey, Hammersmith-Fulham and Kensington-Chelsea — among working class, middle class and (upper) middle class families respectively. Methodologically, the goal was to innovatively mix in-depth interviews with participant observation and creative, digital methods.

★ What led you to do this research in this area?

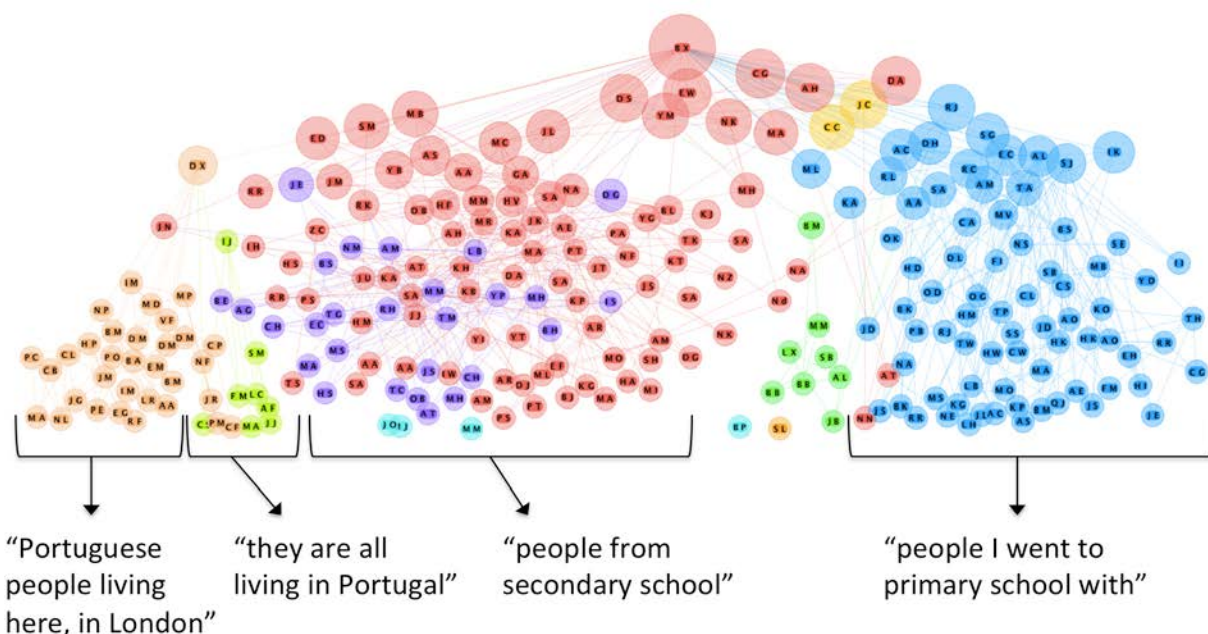
When I began conducting research for UPLOAD, urban encounters and

multiculturalism on social media were yet to be put on the scholarly agenda, and we needed a better understanding of two entangled processes: living together with difference in urban environments and the socio-political relevance of everyday internet use among young people.

As social media and mobile devices have become an important part of young people's everyday lives, there is an urgency to gain greater insights into whether their use of internet applications corroborates pan-European sentiments of failed multiculturalism and ethnic segregation or whether their experiences instead foster intercultural dialogue and cosmopolitan understanding.

★ What have you learned from your research so far? Is it any different from what you expected?

In the figure I have given you, you can see the Facebook friendship network of Xavier, a 13-year-old London-born





© Koen Leurs

DR. KOEN LEURS

Portuguese boy. A few of his contacts live in Portugal, others are Portuguese people living in London, however, the majority of his contacts are local friends of various backgrounds. When discussing these various contacts with him, he said: 'The thing is, especially in a country like this, there are [people from] so many different countries. You can't really discriminate. I prefer to learn.'

"A diverse racial or religious composition of their neighbourhood and school is reflected in an equally diverse social media friendship network."

We interviewed 84 young Londoners like Xavier. We have just completed transcribing the audiotapes of the interviews and we are currently coding the transcripts to develop theories. As little is known about the topic of digital multiculturalism, we seek to develop new theories and methodologies grounded in the everyday experiences of our informants. Two related insights are worth sharing here, one conceptual and one methodological observation.

Methodologically, we quickly realised that a meaningful study of social media would entail using digital tools to gather data. But we also wanted to have informants involved in gathering data. So we chose to visualise the Facebook friendships of interviewees active on Facebook, and used this visualisation to have them research their own network. As Xavier's narrative illustrates, this new technique is useful for triggering strong reflections among the

informants, as they can participate in making the visualisation and have a say on their own representations.

Conceptually, we found that both white British as well as young Londoners of migrant descent predominantly use social media such as Facebook to connect with fellow young people who live locally. Thus, we realised it is problematic that previous studies on internet use among ethnic minorities mostly focused on transnational communication and encapsulation with co-ethnics and contacts overseas. Social media seem to be a place where young people befriend other youth who live in their surroundings. A diverse racial or religious composition of their neighbourhood and school is for example reflected in an equally diverse social media friendship network. People commonly post about their cultural background, and social media thus provide a meaningful way for users to learn more about diversity

★ **What were the main difficulties you faced in your research?**

Two main difficulties can be mentioned. First, our plan to conduct interviews with roughly 90 informants was very ambitious. In contrast with the working class area of Haringey where we were greatly assisted by parents, local councils, youth workers, youth clubs and libraries, upper middle class families in Hammersmith-Fulham and Kensington-Chelsea were reluctant to get involved. It is important to reflect on the implications of an apparent reluctance in richer families to participate in research.

Secondly, and although very exciting, this research project illustrates the tough balancing acts required when pursuing an academic lifestyle. My wife and I took up the challenge to move to London so that I could start the study only five weeks after we welcomed our son into our family. Luckily my new colleagues, my family members and my friends were very supportive.

★ **You chose to focus on London. Why? Do you think your results are likely to apply to the rest of Europe?**

As more than half of the world's population live in cities, empirically-grounded insights into multiculturalism in the city are important, especially given the recent upsurge of racialisation, discrimination and religious extremism across Europe.

London is an illustrative case in point, as more than 50% of the population are from ethnic minorities. Although London has its own particular dynamics, our findings are illustrative for larger urban cities across Europe and they can inform policies around cultural diversity and migration.

★ **What do you think could or should be done to turn social media channels into real platforms for cultural exchange?**

Our study shows that young Londoners already use social media as platforms for cultural exchange. Like in the offline context, ethnic strife and violence is an exception to the rule. When the 2011 BlackBerry Messenger London riots happened in Tottenham, newspaper headlines such as 'Is technology to blame for the London riots' and 'These riots were about race. Why ignore the fact?' indicate that the two issues of race and digital technologies were singled out as key drivers of the riots. New technologies and race however do not lead to chaos. Nor can social media platforms themselves drive intercultural understanding. It is the users themselves who choose to use social media as loci for cosmopolitan encounters. It is up to us researchers to be attentive to this dynamic, and in their everyday social media use young Londoners bridge racial and religious differences by maintaining intercultural friendships.

★ **Now that the project is getting close to its end, what would you like to do next?**

A small group of the young Londoners interviewed came to the UK as asylum seekers. Hearing their experiences about using the internet to carve out a livelihood in London, I realised there was a lot to learn about the European social media/forced migration nexus. In future research, I aim to explore to what extent digital practices of young asylum seekers reflect their human rights, and especially their digital communication rights. Also, and of particular urgency for the EU, I will seek to better understand in particular how asylum seeker youth engage in informal networked learning to gain the cultural capital needed for successful migration and acculturation.

UPLOAD

- ★ Coordinated by the London School of Economics and Political Science.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/project/rcn/108300>

SECOND LANGUAGE EFFECT ON BILINGUAL READING DEVELOPMENT

Some children being taught to read in two languages simultaneously are struggling. An EU-funded project has determined that the second language plays a key role in reading ability.

The EU-backed BIRD (Bilingualism impact on reading development) project set out to determine the degree to which linguistic features favourably or adversely affect reading development. The overall aim was to provide better awareness of literacy growth.

Project members tested children at bilingual primary schools in the Basque Country over a two-year period. The children were learning to read in Basque together with either French or Spanish. They were matched by age and by language use and exposure measures and mainly assessed in Basque reading and cognitive skills.

Test scores revealed that the Basque-Spanish bilingual children had few problems learning to decode new words. As a result, they learnt to read in Basque quite quickly. In contrast, Basque-French bilingual children had much more difficulty learning to decode new words, therefore reading in Basque came more slowly.

French has a more complex sound-letter correspondence and more irregularities. Readers must learn the arbitrary or unusual pronunciations of irregular words.

There was a significant difference between the two groups in their ability to distinguish and manipulate individual sounds in non-words. Basque children learning to read in Spanish were better at using the sounds of the Basque language than their French counterparts.

However, the Basque-French second graders had much more acute visual attention span skills. These enhanced skills are a result of the French language's less direct correspondence between letters and sounds. By grade five, the difference did not exist. This may indicate that older children in both language groups display similar whole-word strategies and have built up lexical knowledge.

Ongoing work in BIRD will lead to the design of diagnostic tools for literacy delays and disorders. The project should facilitate future literacy acquisition programmes in European bilingual communities such as Brittany, Catalonia, Galicia and Wales.



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“There was a considerable difference between the two groups of fifth graders in their ability to distinguish and manipulate individual sounds.”

Spanish has a very clear correspondence between letters and sounds, and the spelling of words is quite consistent.

BIRD

- ★ Coordinated by the Basque Center on Cognition, Brain and Language in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151914>

THE DEVELOPMENT OF ANXIETY IN CHILDHOOD

As the name suggests, the ANXIETY IN CHILDHOOD project focused on anxiety disorders developed in childhood. Studies conducted during the course of the project revealed new findings on how parents interact with children suffering from anxiety and on anxiety in high-risk youths.

The team believes that the findings will shed light on preventive measures and targeted treatments, and the group's work is already generating much interest among experts working on the ground in these areas. The team has also developed a new way of analysing data, and is currently busily coding project data according to this new scheme for three papers to be published this year.

The EU-backed project ANXIETY IN CHILDHOOD (Approaching an answer to the complex question ‘how do childhood anxiety disorders develop?’ by merging attachment and social learning theory and their methodologies) officially drew to a close in August last year. It comprised two primary studies — the first was a longitudinal study of high-risk youth that focuses on attachment theory, while the second

explored the role parents play in the development of anxiety in youth.

The first study focused on adolescents in the afterschool programme at the Centre for Attachment Research. Data were collected for 45 adolescents between the ages of 13 and 15.

Results from this study showed that 17% of these high-risk youth suffered from anxiety, compared to 5 to 10%



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Research fellow Barbara Hoff Esbjørn explains that an important aspect of this study was that it included children who were both typically developing and clinically anxious — this offered a case control which matched for gender and age. ‘As far we know,’ notes Hoff Esbjørn ‘nobody has done this for a study on attachment in this area before.’

“The group’s work is already generating much interest among experts working on the ground in these areas.”

What the research team found was that anxious children are no more insecurely attached than typically developing children. And when they looked at response to treatment, it was demonstrated that if the mother has attachment anxiety then their children are less likely to have positive outcomes from treatment. Hoff Esbjørn notes, ‘That is a significant finding and quite new – it has not yet been published. It’s important because it tells us what we need to target when talking to parents.’

Now the team is looking into different types of treatment and talking to parents about what happens when the child stops being anxious — however it’s not something they have data on yet.

Professionals working in this area in Denmark have shown great interest in the project work. The team has engaged with municipalities in Denmark on a pilot project, and other municipalities are proactively contacting them to get involved. A recent workshop with professionals in Copenhagen was heavily oversubscribed with 170 applications received, so the team is planning a follow-up to cater for demand.

The research team expects to publish a further three papers on this second study over the course of the year to come.

in the general youth population. Because these results are specific to high-risk youth, they cannot be generalised for all populations. Therefore, additional research needs to be conducted on different samples of youth populations.

The study appears to show that the quality of peer relationships contributes to the development of anxiety, as well as attachment insecurity. Furthermore, given the higher rates of anxiety among high-risk youth, these findings also highlight the need for a

cost-effective intervention programme for this population.

For the second study, preliminary data has already been presented at one conference and accepted for another. The team is currently applying a new coding system that was developed over the course of the project — the old scheme, they found, was not accurately capturing what was going on. This new system, which could be taken up by other research teams, looks at reciprocity of behaviour between the parent and the child.

ANXIETY IN CHILDHOOD

- ★ Coordinated by the University of Copenhagen in Denmark.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151420>

BIOLOGY AND MEDICINE

MEDICATION TIMING KEY IN CANCER TREATMENT

An internal clock determines many of our bodily functions. The same is true for tumour cells, EU-funded research suggests. This discovery could point the way to a more efficient, personalised approach to cancer treatment.

The biological clock located in our brain regulates hundreds of biochemical, physiological and behavioural processes that rhythmically oscillate in our body throughout the day. These 24-hour circadian rhythms are found, in mammals, in virtually every individual cell in the body. Every day circadian rhythms are synchronised to the outside world, and daylight is one of the most important synchronisers.

There are circadian rhythms in many aspects of disease as well. The intensity of signs and symptoms rhythmically changes in the course of the 24-hour day. The same is true of our body's receptiveness to medication. Here is where the concept of chronotherapy — the application of treatment at the most optimal time of day to increase therapy success — comes into play.

The right timing

'During the last 30 years, the potential of using chronotherapy to improve the efficacy of anticancer therapy has been demonstrated,' says Maria Comas Soberats, the beneficiary of the EU-funded CANTERTIME (The biological clock and cancer) research grant. Thanks to CANTERTIME, she was able to spend two years at the Roswell Cancer Institute in Buffalo (USA), and one year with the Department of Microbiology, Tumor and Cell Biology at the Karolinska Institute in Stockholm (Sweden), one of Europe's leading medical research institutes.

So far, few hospitals have taken advantage of the benefits of chronotherapy. This is partly because the

best time to apply many types of treatment is during the night when there is a lack of infrastructure and personnel. In addition, little is known about the mechanisms that relate specific cancer treatments to the circadian clock.

Guardian of the genome

'If we can understand how daily patterns of toxicity and sensitivity to cancer treatment vary throughout the day and how chronotherapy functions at the cellular level for each type of treatment, this should stimulate novel approaches for treating the disease,' explains Comas Soberats. 'In this project, we have done this type of study for several potential anticancer drugs that target the p53 protein which has been described as "the guardian of the genome".'

The p53 protein regulates the cell cycle in multicellular organisms such as animals and humans. It plays a central role as a tumour suppressor, preventing genome mutation and thus cancer. Through CANTERTIME, Comas Soberats found that there was a link between p53 and the circadian clock. She and her colleagues tested several drugs that target the p53 protein and that could be candidates for chronotherapy targets.

In addition, Comas Soberats discovered that all of the tumour types investigated during CANTERTIME retained a functional clock that was synchronised with the surrounding tissue.

The clock is ticking for cancer

Kept alive in a petri dish, these tumours can even continue to oscillate for several days once they have been removed from the body. This confirms that the circadian clocks in these tumours can keep working even when they do not receive hormonal or metabolic signals from surrounding tissue. This knowledge will help design chronotherapy strategies for cancer patients.

As a result, anticancer therapy will become personalised over the coming years: doctors will take a sample of each tumour and will determine its specific genetic characteristics. In combination with more information from that specific patient, they will be able to design a personalised treatment that will provide the highest chance of success for that individual.

Every individual has a specific chronotype, depending on what time of the day their physical functions (hormone levels, cognitive faculties and sleep, for example) change or reach a certain level. Both the patient's chronotype and a chronotherapeutic approach should be taken into consideration in the personalised treatment of cancer, concludes Comas Soberats.

CANTERTIME

★ Coordinated by the Karolinska Institute in Sweden.

★ Funded under FP7-PEOPLE.

★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33998

STUDYING STRESS AND HEALTHY AGEING

With falling birth rates and increased life expectancy, Europe is now the oldest continent. An EU-funded project has studied factors that contribute to healthy ageing.

The project NINA (Neuroendocrine immune networks in ageing) focused on three systems crucial for health and longevity: the central nervous system, the immune system and the endocrine system. NINA, a Marie Curie Initial Training Network, supported 15 research fellows (13 early-career and two experienced researchers), who studied the impact of ageing on these systems at 10 world-class institutions.

Research projects investigated a range of issues related to ageing with a focus on stress. These included: the effect of sleep duration and quality on the immune system; the effect of hormones secreted by adipose tissue on the immune system; the effect of the stress of caregiving on young and older adults; and the impact of early life stress on epigenetic programming.

In one study with rodents, researchers found that animals with lower circulating thyroid hormones had a longer lifespan. Furthermore, these animals were also resistant to diet-induced obesity, suggesting that one secret to long life may be a more adaptable response to food intake by the hypothalamus.

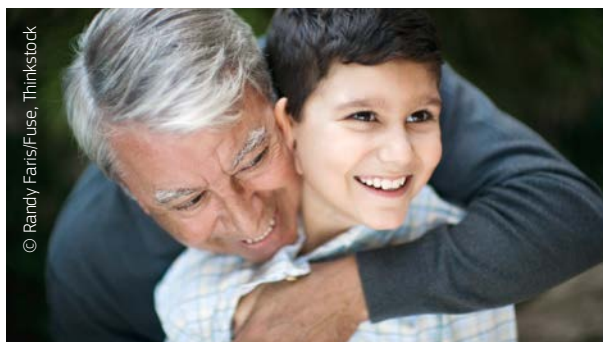
Other findings point to the role of stress in ageing. In rodents, researchers were able to identify the early-stress response region in the promoter for the glucocorticoid receptor and how hypermethylation improved this region's response to stress. In human studies on psychological stress, this was found to have a negative impact on immunity in both young and older adult caregivers, but was more pronounced in older adults. Researchers also found that physical activity improved sleep in older adults, a cause of stress in old age, and this should add more weight to the benefits of physical activity for healthy ageing.

In another study, researchers were trying to develop ways to improve immunity in older adults and in particular how to overcome the age-related deterioration of the thymus. They experimented with ways to use stem cells to regenerate the thymus and improve responses to vaccination, and showed that they could regenerate a thymus in rodents.

These findings have many applications. Identifying the endocrine response to feeding early on in life may help indicate those with a more adverse response to overeating. Furthermore, simple lifestyle changes, such as increased physical activity — which leads to sounder sleep — may go a long way to promoting healthy ageing.

NINA

- ★ Coordinated by the University of Birmingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155982>



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NOVEL APPROACHES TO BRAIN SCIENCE

Neuroimaging probes the mysteries of the brain and offers a first-hand look at the human body's most important and complex organ. EU researchers joined forces to advance the know-how of this relatively new and constantly evolving discipline.

Doctors and neuroscientists use neuroimaging technologies in the diagnosis and treatment of brain injuries and disorders. Thanks to recent advances, they are better able to identify areas of injury and trauma to the brain. Research

using such technology now also helps professionals to treat those with various learning, social and emotional disorders.

Neuroimaging is making rapid progress in brain imaging techniques such as

'Magnetic resonance imaging' (MRI), 'Positron emission tomography' (PET) and 'electroencephalography' (EEG), as well as in research and analysis.

The field is still in its infancy, despite explosive progress. The EU-funded project NEUROPHYSICS (Methods in neuroimaging) formed an interdisciplinary network of scientists to identify, combine and design new methods for neuroimaging by carrying

out research and training activities. The overall goal was to put neuroimaging on the research map and drive forward the prevailing impact of the discipline.

Team members focused on brain neuroimaging by placing special emphasis on approaches for clinical use. It used and operated MRI, PET and EEG scans and other technology made available for the project. The researchers were able to supply new imaging hardware, data acquisition and data analysis tools, as well as design new systems integration methods.

The strong multidisciplinary and integrative research methodology of the NEUROPHYSICS network has opened up new brain imaging avenues. By introducing innovative clinical approaches to neuroimaging, the project is putting Europe at the cutting-edge of brain science.

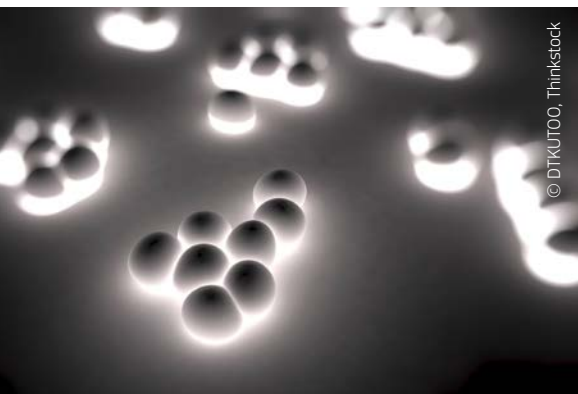
NEUROPHYSICS

- ★ Coordinated by the University of Maastricht in the Netherlands.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/154485>

"The researchers were able to supply new imaging hardware, data acquisition and data analysis tools, as well as design new systems integration methods."

THE EVOLUTION OF RESISTANT BACTERIA

A European study has investigated the mechanisms by which antibiotic-resistant bacteria evolve. The genetic determinants of this process could have important implications for the spread of microbial resistance.



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Bacterial resistance to antibiotics is a major hurdle when fighting many infections. Numerous research efforts try to address the problem by identifying novel targets and synthesising new compounds with antimicrobial function.

Equally important, however, is understanding the evolutionary and genetic factors that drive the emergence and

spread of resistant pathogens. In this context, the EU-funded SPECRESEVO (Specificity of antibiotic resistance evolution) project set out to elucidate how resistance is affected during evolution and in different environments.

Partners isolated resistant bacteria experimentally using conventional protocols, and subjected them to different growth conditions. Additionally, they isolated bacteria with a different history of antibiotic exposure and found that the effect of mutations associated with resistance is largely dependent on the environment and the genetic background. Therefore, we need to understand these mechanisms first before we can predict bacterial spread and minimise antibiotic resistance.

Furthermore, partners studied how resistant bacteria grow in the absence of antibiotic pressure. Resistant bacteria continued to have increased fitness, compared to normal species, without reverting to drug sensitivity, clearly

underscoring the necessity of genetic studies to identify the loci implicated. This competitive fitness was mutation-specific and also depended on the genetic background of the pathogen.

SPECRESEVO's work proved the principle that experimental microbial evolution is a valid approach for determining key aspects related to antibiotic resistance. Collectively, the information generated sheds light onto the complex process of resistance-mediated fitness and suggests avenues to prohibit resistant bacterial spread. Long-term, this is expected to improve health care and minimise related costs.

SPECRESEVO

- ★ Coordinated by ETH Zurich in Switzerland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155892>

CLOSING IN ON A POWERFUL THERAPEUTIC

Cytotoxins, compounds toxic to cells, abound in nature as one organism's way of protecting itself against another. Scientists have investigated the synthesis of a newly discovered family of these that could help protect people against cancer.

Humankind's use of cytotoxins abounds, with examples ranging from beauty treatments and natural pesticides to various disease therapies. Madangamines, a novel group of pentacyclic (containing five rings) cytotoxic alkaloids from marine sponges, are receiving growing attention for their ability to kill cancer cells.

To date, six members have been isolated and named madangamine A to F. However, synthesis is a complex, multi-step pathway involving numerous reactions. Total synthesis (complete synthesis of an organic molecule from precursors) and industrial-scale production would provide important new weapons in the battle against cancer. This provided the impetus

"Researchers successfully carried out numerous synthetic steps that brought them to the threshold of the madangamine D molecule."

for the EU-funded project POWORMAD (A powerful enantioselective organocatalytic approach to the total synthesis of madangamine alkaloids).

All madangamines discovered so far have the same tricyclic core consisting of ABC rings. The project explored two synthetic strategies, fast and efficient ways to synthesise the common tricyclic core and similarly easy ways to build the other macrocyclic rings that are fundamental to biological activity. Scientists started with

madangamine D, as the saturated macrocycle D necessary for the synthesis of madangamine D can be made from several different reaction pathways.

Synthesis of madangamine D requires over 20 synthesis phases, including many with enantioselective formation of certain products. This means that two compounds of identical chemical formula but different chemical structure must be distinguished, and only one included in the reaction. The difficulty and complexity of the reactions has made the total synthesis of this molecule quite elusive.

The project combined catalysis, total synthesis and structure elucidation. Researchers successfully carried out numerous synthetic steps that brought them to the threshold of the madangamine D molecule. Its first total synthesis will be a milestone in the history of organic synthetic chemistry and open a door to a novel, natural way to stop cancer cells in their tracks. POWORMAD has made an important contribution to realising that event.

POWORMAD

- ★ Coordinated by the University of Oxford in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/154508>

IMAGING WATER MOVEMENT IN TISSUE

Microstructural tissue changes related to development, ageing and disease processes affect the diffusion of water. Scientists investigated and employed an important new imaging technique that exploits this phenomenon with pioneering outcomes.

‘Diffusion tensor imaging’ (DTI) is a magnetic resonance imaging-based technique. It can be used to map the diffusion of water in three dimensions as a function of spatial location and to describe differences in diffusion rates along all three axes (anisotropy).

Despite its growing popularity for research and clinical applications, the actual mechanisms affecting the diffusion tensor are not clear. Theoretical models of displacement fail to predict the water movement and some reports have suggested that neuronal activity can modify it.

With EU funding, the project MMDTIAN (Multi-modal diffusion tensor imaging of active neurons: Searching for functional and other biophysical components) employed three different types of imaging on neuronal cell culture to investigate that possibility. The use of organotypic cell cultures having more than one cell type in a 3D tissue network mimics the in situ situation without noise from blood flow.

The unique experimental paradigm employed excised vital newborn rat spinal cord. Researchers showed for the first time that enhanced neural activity affects water displacement in

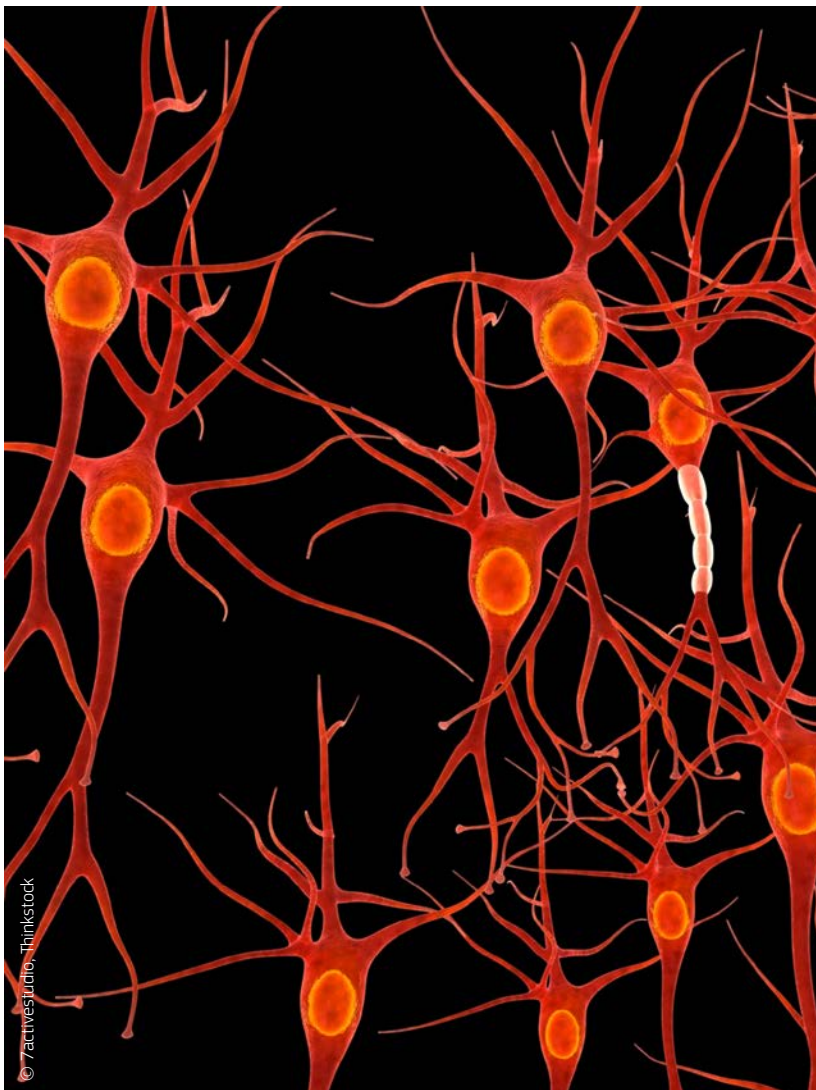
“The team developed faster and better imaging using an inexpensive, mobile unilateral NMR scanner.”

a way that is not merely a side-effect of blood oxygenation levels, supporting a potential mechanical role. This groundbreaking demonstration won several awards for innovation and led to an important publication in a peer-reviewed scientific journal.

In addition to biomedical applications, diffusion plays a role in many industrial devices. The team developed a novel method to estimate pore size distribution from multiple diffusion-weighted ‘Nuclear magnetic resonance’ (NMR) imaging measurements. It provides access to experiments and results previously not achievable and has also led to several publications, including one for applications to porous polymers.

Finally, the team developed faster and better imaging using an inexpensive, mobile unilateral NMR scanner. The mobile NMR led to several papers and is currently being used in a clinical application through another project.

The MMDTIAN project has significantly advanced our understanding of the mechanisms behind an important new imaging technique, DTI, and applied it with impressive results. The outcomes are relevant to a variety of fields and opening a new window on the world around us.



MMDTIAN

- ★ Coordinated by Tel Aviv University in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155882>



BRAIN ENERGY SUPPLY AND INFORMATION FLOW

Unlike in other tissues, a complex flow of information between brain cells regulates blood supply. Elucidation of the mechanisms coupling brain energy supply with energy use is essential for understanding the mechanisms of neuropsychiatric disorders.

Alterations in neurometabolic function are detected in many neurological disorders such as depression, Alzheimer's disease and schizophrenia. The EU-funded BRAINENERGYCONTROL (Quantifying control of brain energy supply by the neuron-glia-vasculature unit) project investigated the relationship between information flow in neuronal circuits and the trafficking of metabolites between neurons and glial cells. To achieve their objectives, scientists used a combination of mathematical modelling and in vitro imaging experiments.

One important project discovery demonstrated that efficient transmission of information at a synapse in the presence of noise requires a low release probability at synapses. This is the optimal solution for maximising information transmitted per metabolic cost. This provides an explanation for the previously poorly understood fact that synapses are unreliable, often releasing neurotransmitters in only 25% of the times that a presynaptic action potential arrives.

Similarly, experiments in rat lateral geniculate nucleus relay cells showed that the amplitude of postsynaptic currents is set to maximise the ratio of information transmitted in relation to postsynaptic energy consumption. These results suggest the existence of homeostatic mechanisms that regulate both energy consumption and information transfer at synapses.

The project's results extend our understanding of brain energy use by examining 'adenosine triphosphate' (ATP) consumption in non-signalling tasks in the brain which could consume up to 50% of the brain's ATP. Researchers found that most of this non-signalling energy use is expended on turnover of the actin and microtubule cytoskeleton.

In conclusion, BRAINENERGYCONTROL presented a model of metabolic interactions of the neuron-glia-vasculature ensemble. This model provides a template for large-scale simulations of this ensemble and for the first time integrates the respective timescales at which energy metabolism and neuronal excitability occur.

BRAINENERGYCONTROL

- ★ Coordinated by University College London in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155946>

SOCIAL SCIENCES AND HUMANITIES

THE PSYCHOLOGY BEHIND GREEN TAX EFFICIENCY

The way in which tax reform affects consumer psychology and thus consumption must be understood for green tax to efficiently curb pollution. An efficient balance must be found between the visibility, effectiveness and acceptability of excise tax.

One solution to the growing issue of environmental pollution is implementing green tax (tax imposed on the emission of pollutants and goods whose use pollutes). Such a tax, or fiscal signal, will hopefully curb environmentally harmful behaviour and raise awareness of emissions. The EU-backed ALLEGRO (Consumer behaviour and Energy

that best curbs emissions but is still accepted.

Research was developed in two phases. The first phase focused on providing evidence of psychological effects preventing acceptance of green taxes, specifically how delayed benefits of taxation correlate with low support. Partners found that change doesn't occur when the negative external effects of consumption are delayed, as is the case with most environmentally consequential actions. In other words, people are less likely to see green taxes as motivation to change behaviour if they can't witness the benefits of reducing them.

The second phase involved the analysis of consumers' reactions to price versus tax changes. Research showed that reaction to a gasoline tax change is, on average, about 20% stronger than reaction to a corresponding price change. Consumers are more likely to

react or alter behaviour in response to a visible change in tax as opposed to a change in tax-inclusive prices.

These findings are significant as they show that the more visible the tax is, the more likely consumers are to alter behaviour or curb emissions. ALLEGRO suggests that greenhouse gas emissions would still be reduced even at a lower rate than currently suggested, as long as visibility is increased. A lower green tax rate would avoid the usual consequences of effective taxation (where behaviour is altered but lacks support). It will also allow greater public support of these taxes while we wait to see the positive effects of reduced emissions.

ALLEGRO

- ★ Coordinated by the University of Siena in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155953>

"Reaction to a gasoline tax change is, on average, about 20% stronger than reaction to a corresponding price change."

Taxation: Exploiting Psychological Biases in Designing a Green Tax Reform) project studied the effects of different tax designs on consumer psychology, searching for the design

UNDERSTANDING THE ROMAN EMPIRE'S ELITE

A look into the social and cultural effects of the Roman Empire gives way to a better understanding of the modern elite in Europe.

"The increased number of public institutions did not create conflict between the state and the aristocrats."

Europe in the last two decades has seen the formation of transnational elites in the educational, managerial and administrative realms. Understanding the impact of this development requires going back to the time of the Roman Empire. It was in the late third and fourth centuries that a new governing class was created

which brought together aristocrats from all across the Mediterranean World.

The EU-funded TRANS-REGIONAL ELITE (Trans-regional elites in the later Roman Empire) project examined the significance of this development. Key areas of focus were how the formation of a trans-regional elite reshaped the ways in which its members lived and viewed their place in the world.

What was discovered in the course of the project was that the increased number of public institutions did not create

conflict between the state and the aristocrats. Instead, it helped to form a new self-understanding. Roman aristocrats increasingly saw themselves as a global and unified aristocracy. Superiority was based on moral excellence and loyalty to the Roman Empire.

Research results were presented to the scholarly public via two books and five peer-reviewed articles. One book addresses the social and cultural effects of the creation of a new trans-regional governing class in the later Roman Empire. The other examines trans-regional elites in ancient Eurasia from a comparative perspective.

Beyond academic benefits, the project led to the creation of new research collaborations between Europe and the United States.

TRANS-REGIONAL ELITE

- ★ Coordinated by Ruprecht-Karls-Universitaet Heidelberg in Germany.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155972>

BRINGING ARISTOTLE TO THE PEOPLE IN 16TH CENTURY ITALY

Antonio Brucioli, a sparsely researched 16th century Italian translator, helped spread knowledge of Aristotle through the country.

During 16th century Italy, translators contributed to the spread of knowledge by translating works into the language of the people, or the vernacular. One such translator was

"The project will produce a monograph offering a clearer picture of Brucioli's life."

Antonio Brucioli of Florence. The EU-funded project ABRUCIOLI (Philosophy for the People? Antonio Brucioli as translator of Aristotle in sixteenth-century Italy) took a closer look at the translator, reassessing what is known about his life, education and works.

The project discovered new texts translated by Brucioli and also corrected the commonly understood chronology of his works. It found that Brucioli largely focused on translating Aristotle's works of natural

philosophy, but that he also translated the Bible, Cicero, Pliny and Sacrobosco.

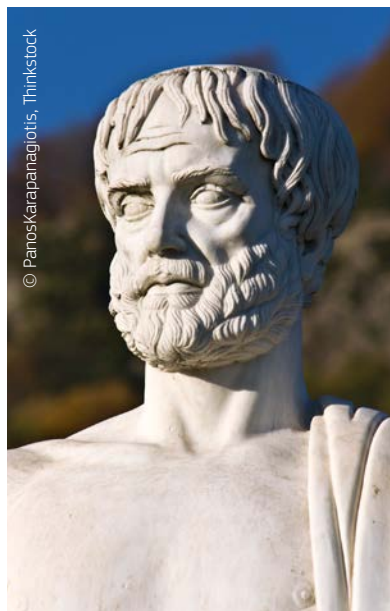
ABRUCIOLI also theorised as to why Brucioli translated these works and revealed that the key motivation was practical — i.e. monetary gain. While Brucioli's target market was university students, his reach was unfortunately small during the time. The reason for this is that the translator was tried several times for heresy and his works were prohibited.

This led to the theory that an additional motivation for his translations may have been to gain political protection. Not able to meet with much success in Italy, life improved for Brucioli when he moved to France.

The project will produce a monograph offering a clearer picture of Brucioli's life. Overall, ABRUCIOLI has generated new knowledge on the translator's contribution to the development of vernacularised works during this period in history.

ABRUCIOLI

- ★ Coordinated by the University of Warwick in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/150758>



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INNOVATIONS IN THE STUDY OF PARCHMENT

Parchment was the medium of medieval Europe. An EU-funded study has developed an innovative, non-destructive way to identify the animal species used to develop this material.

The project PALIMPSEST (Unlocking historical and molecular archives) used mass spectrometry of minute quantities of collagen to identify the correct species used and to learn about parchment quality and methods of production. The non-destructive sampling technique was developed in close collaboration with conservation departments.

Using materials compatible with standard surface conservation treatments, the team was able to extract minute amounts of collagen from the residue produced as a result of cleaning. The collagen proved to be the key to identifying species used to make the parchment. The simple procedure requires no specialist training and puts the sampling in the hands of those comfortable with these materials (conservators and curators).

Because the methodology is safe for old documents, the team had unprecedented access to libraries and archives. Over the course of the project, researchers analysed in excess of 1 000 documents spanning three continents and covering a period of 1 400 years.

In addition to animal identification, researchers were able to evaluate a specific type of damage that occurs in the collagen molecule. The damage is related to the quality and method of production of the parchment, or the time exposed to lime for dehairing. This discovery provided insight into changing manufacturing processes.

The project resulted in an international network, with partners in Europe and the United States. The rich collections found in institutions in these countries have the potential to provide a more complete picture of parchment use throughout the Middle Ages.



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PALIMPSEST was successful on many fronts. It produced a wealth of data, as well as a non-destructive sampling technique with the potential for numerous applications. Not only does project work represent the beginning of a new stage in manuscript studies, it also introduced the concept of biomolecular codicology, opening the field to further analysis and interest from multidisciplinary perspectives.

PALIMPSEST

- ★ Coordinated by the University of York in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155945>

WORK-LIFE BALANCE TO THE RESCUE

The concept of corporate family responsibility can encourage better work-life balance to make employees happier and businesses more productive.

More often than not, the corporate world focuses mainly on financial results and benefits of stockholders, without giving adequate consideration to the work-life balance of employees and the consequence this has on families. On the other hand, good practices in management insist on better social responsibility and sustainable development, including the well-being of people and families. NIFREI (The effects of work-life balance on companies,

individuals, and their families from around the world) was a recent EU-funded project that investigated how family-friendly policies affect employees' lives and their work performance.

Specifically, the project looked at the emergence of 'Corporate family responsibility' (CFR) as a key internal aspect of corporate social responsibility. CFR, which calls on integrating work, family and personal life, is meant to foster commitment, satisfaction, competitiveness, flexibility and sustainability.

To achieve its aims, the project team examined research from the International Center for Work and Family at the IESE Business School in Spain. It particularly looked at how the IESE Family Responsible Employer Index (IFREI) measures CFR and its impact on people,

society and company results in 21 countries around the world.

Importantly, the project noted that 54% of people in a key IFREI study said they work in a difficult and hostile environment regarding family and integration. It also found that even within the same organisation, some environments enable employees to integrate their work and family life while others find it much more difficult. This is due to a lack of flexibility policies and the communication of these policies, as well as diverse management styles and subcultures that generate different microclimates in the same company.

Among the study's important findings was that if employees perceive that their managers encourage CFR, they are half as likely to leave the

"54% of people in a key IFREI study said they work in a difficult and hostile environment regarding family and integration."



company, their motivation more than doubles, and their level of commitment is higher. This requires emotional support and better role models in management, in addition to reorganisation and flexibility in the workplace.

Overall, CFR can help reduce working hours, minimise absenteeism and enhance productivity. It promotes corporate flexibility, bringing out the best

in employees and encouraging gender balance. If exploited wisely, the project's findings can help companies achieve these benefits and become more sustainable.

NIFREI

- ★ Coordinated by the University of Navarra in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155860>

CHINESE VIEWS OF DEMOCRACY

An EU team has surveyed attitudes to democracy among Chinese people. The study examined three strata of Chinese society, in several Chinese locations, and assessed support for liberalisation.

Many European universities have strong interests in issues affecting China, in addition to research relationships with Chinese organisations. One critical topic is that of democracy, and the likelihood of China ever attaining it.

The EU-funded project CHINESEDEMOCRACY (Chinese perceptions of democracy) was a collaboration between the University of Nottingham and the Chinese Academy of Social Sciences. The goals of the two-year study were to examine Chinese perceptions of democracy via interviews, and to predict the direction of Chinese political reforms. The undertaking concluded in December 2013.

Project partners conducted field interviews in China, over several phases. The pilot survey began in early 2012 and was centred on three Chinese cities. The purpose was to assess the interviewees' responses to the research topics and questions. Thirteen interviews were conducted.

The project held an expanded round of interviews later that year in five Chinese provinces. The team conducted 62 interviews, surveying three social levels: government officials, business owners and the 'lower classes'. The information was used for qualitative analysis and questionnaire redesign.

Between March and September 2013, the project questioned a sample of entrepreneurs. Around 300 individuals responded. The data were analysed quantitatively to assess factors affecting the respondents' attitudes towards support for the state and political liberalisation.

Late completion of the analysis resulted in a planned conference presentation being cancelled. The reason for the delay was the political sensitivity of the topic. A revised version of the proposed paper containing policy recommendations was planned for submission to the Chinese government and other Chinese agencies.

The results of the CHINESEDEMOCRACY study helped to enhance the reputation of Nottingham University's School of Contemporary Chinese Studies. The information obtained will also help EU and other agencies address policy and business issues relevant to China.

CHINESEDEMOCRACY

- ★ Coordinated by the University of Nottingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/154487>



ENERGY AND TRANSPORT

HELPING EUROPE'S AVIATION SECTOR RISE TO THE CHALLENGES OF THE FUTURE

Air transport is a growing and increasingly vital part of our rapidly globalising world. At the same time, the aeronautics industry faces an unprecedented set of challenges. Chief among these is the need for greener and more sustainable aviation. For everyone in the industry, the message is clear: successful 'green' innovation will be key.

The EU-funded project CARE (Clean Aerospace Regions) aims to enable Europe's aviation industry, particularly the SME sector, to position itself at the forefront of this drive for innovation and thereby achieve increased competitiveness, economic growth and jobs.

Bringing together a number of regional research 'clusters', each cluster consisting of local enterprises, research and training bodies as well as local authorities, the CARE team has focused on identifying ways to help Europe's aviation industry meet a range of environmental challenges, all requiring very different technologies. These include the need for 'greener' engines, lighter aircraft structures or alternative fuels, as well as for a more sustainable product life-cycle design, incorporating an aircraft's basic manufacturing, maintenance and recycling processes.

'Another area where future innovation will be crucial,' explains Thilo Schoenfeld from France's Aerospace Valley, which acts as project coordinator, 'is the potential that could be unlocked by developing greener air traffic management techniques. For example, one might think a plane would fly straight from one airport to another, but this is definitely not the case,' says Schoenfeld, citing military

restrictions or radar-related issues as key reasons why planes rarely travel 'as the crow flies'.

According to Schoenfeld, there are two other ways in which air traffic could be made greener. One would be finding options to cut the need for aircraft to circle above airports, waiting to land. The second would involve making optimal use of modern technology allowing aircraft to fly longer at cruise altitude, linked to a capability for shorter but steeper landing approaches. This could significantly reduce noise pollution — another important green consideration.

Given that the focus of the CARE project has been on finding ways of stimulating and enhancing the innovation needed to address these challenges, rather than developing the technologies themselves, the core work of the team centred on three key requirements. The first was to maximise the effectiveness of

"One might think a plane would fly straight from one airport to another, but this is definitely not the case."

investments in research and development at regional level. The second was to stimulate the set-up of new regional research-oriented clusters, and the third was to identify and encourage synergies and public-private partnerships at the European scale.

At the heart of the project was the design and implementation of a 'Joint action plan' (JAP), including 21 concrete measures designed to support European innovation efforts by addressing the continent's weaknesses and reinforcing its strengths.

The 21 measures of the JAP were divided into three categories — Excellence, Efficiency and International Visibility. Actions under 'Excellence' included the identification of a common research agenda designed to help coordinate and promote the CARE priorities, as well as the establishment of specialist technical workshops. Actions in the 'Efficiency' category included providing assistance for SMEs in areas such as regulation, standards, the management of intellectual property rights and the fostering of collaboration with major global manufacturers. The last category included an initiative to establish a 'Green Airport' award.

'With its primary expertise lying in the development of regional research capabilities, the main objective of the CARE team was to support the SME segment of Europe's aviation industry,' comments Schoenfeld, 'since it is these

enterprises, rather than the global players, which mainly operate at local and regional level, often as part of the supply chain for the major manufactures. Our aim has been to cover this part of the overall puzzle.'

While they may be less visible than high-profile global names, SMEs are no less vital to the aviation sector ecosystem, creating the bulk of all aerospace jobs worldwide. By ensuring that this vital part of the 'puzzle' is securely in place, the CARE project is expected to help Europe make great strides towards competitiveness and growth in a key industry of the future.

CARE

- ★ Coordinated by Aerospace Valley in France.
- ★ Funded under FP7-REGIONS.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33896
- ★ Project website: <http://care-aero.eu/>
- ★  <http://bit.ly/1MMBZVA>

THORIUM CHEMISTRY REVEALED

New studies into the chemistry of thorium have brought scientists closer to using it as an alternative to uranium in the production of nuclear energy.

Thorium is a metallic chemical element, part of a group within the periodic table known as the actinides. Although it may have important applications in areas like catalysis and clean energy, its fundamental chemistry remains poorly understood.

"Researchers successfully synthesised and characterised a number of thorium and uranium complexes."

The EU-funded THOR (Organometallic thorium chemistry) project was set up to bridge this knowledge gap. It paired scientific expertise in actinide and metallic bonding chemistries from China and the EU with world-class facilities.

Researchers successfully synthesised and characterised a number of thorium and uranium complexes. They used advanced methods to study the nature of the chemical bonds within these complexes, as well as their structure and reactivity.

A number of pioneering insights were achieved, published and presented at international conferences.

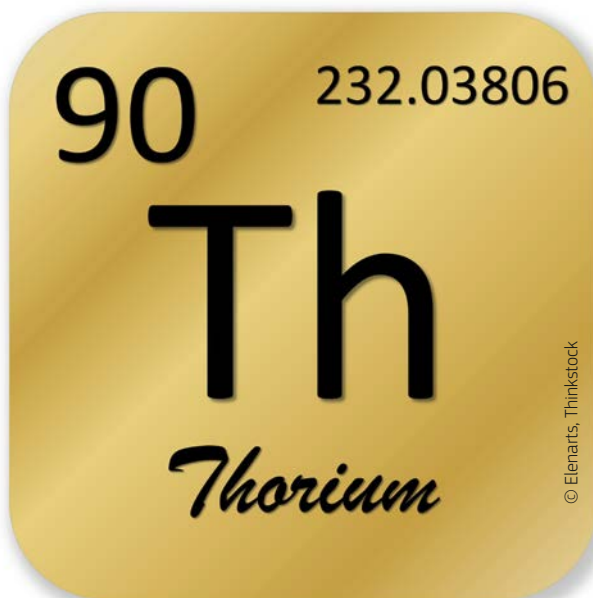
As thorium is both abundant and low in radioactivity, it may be an alternative to uranium for nuclear power, a clean energy source. It may also find use in the remediation of nuclear waste.

The actinide chemistry knowledge produced by THOR thus contributed to strategically important research areas, opening up further opportunities in catalysis, magnetism, materials

and energy science. In addition, EU research in these fields has gained a competitive advantage, as well as long-term collaborations with China.

THOR

- ★ Coordinated by the University of Nottingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155948>



THE SMART CAR APPLICATION



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An EU team has applied smartphone-style application (app) connectivity to cars. The idea enables almost unlimited information services, combining data from the car, environmental nodes or the user's social network to improve control and efficiency.

Connecting cars to the internet via mobile devices and apps offers many advantages. Benefits may include assistance with scheduling and punctuality, improved safety and fuel efficiency, and locally specific public information updates, in addition to monitoring of vehicle operations data.

Making the concept a reality was the EU-funded project CARMESH (Ubiquitous wireless mesh networks for next-generation personal digital automotive services). The consortium aimed to deliver advanced information services to the connected car, using smartphone apps that integrate with automotive interfaces and control systems. The project was administered through the Seventh Framework Programme's (FP7) Marie Curie Action programme, from late 2009 to late 2013.

"The team established new partnerships with European software companies external to the project.."

The team built a prototype intended to showcase the project's vision.

Specifically, the prototype illustrated three business-use cases at the 2013 Automotive Linux Summit. Cases included integration with the business user's calendar to help schedule arrival times, and highlighting locations relevant to the driver's social network. A data-logging application was also integrated with standard automotive interfaces. Project members used two industry events to successfully present their prototype applications.

Using secondments, the team established new partnerships with European software companies external to the project. Subsequently, the project negotiated with software and automotive companies for possible inclusion of CARMESH prototypes in their product portfolios.

Dissemination work included an extensive web presence, including various information videos and articles. The project's second workshop was reported in specialist media, as was a project member's receipt of best paper award at an industry conference. Project personnel also participated in Marie Curie programme events.

The CARMESH project offered automotive integration with smartphones, bringing a range of potentially useful information services to the table. The project helped European business access a potentially lucrative market for such services.

CARMESH

- ★ Coordinated by University College Dublin in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/154488>

CHIC BRINGS FUEL CELLS BUSES A STEP FURTHER TO COMMERCIALISATION

In November 2014, five major bus manufacturers committed to putting fuel cell buses on European roads. A total of 500 to 1000 buses will be deployed by 2020, with over 30 cities having already declared their interest. Initiatives such as the CHIC project, which aims to bring fuel cell technology closer to commercialisation, will be key to enabling such a large-scale deployment.



If you happen to live in Hamburg, London, Oslo or Milan, chances are that you have already seen the fruits of CHIC's hard work: a bus looking somewhat close to normal, notwithstanding a CHIC sticker and the wonders of technology under its hood. Since 2010, CHIC (Clean Hydrogen in European Cities) has been demonstrating fuel cell buses with a view to making them a drop-in replacement for conventional diesel buses. CHIC is building on previous fuel cell bus projects and has succeeded in more than doubling their range, increasing their efficiency, speeding up fuelling operations and reducing cost — the four of which used to form the main remaining barrier to large scale commercialisation.

"The CHIC vehicles all use an optimised hybrid drivetrain and have more than halved fuel consumption."

Before the project was initiated, the typical fuel cell bus had a range of under 200km, took 30 minutes to fuel and cost about EUR 1.8 million. But now the technology has come a long way: 'The CHIC vehicles all use an optimised hybrid drivetrain and have more than halved the fuel consumption [of fuel cell buses]. New state of the art fuelling systems have been installed which have met or exceeded reliability expectations and delivered refuelling speeds consistently below the 10 minute project target', explains Ben Madden, director at Element Energy, who is leading dissemination work under the CHIC project. CHIC's 12m buses consume an average 8kg of hydrogen per 10km, which also makes them 10 to 40% more energy efficient than their diesel counterparts.

A worthy cost

Cost, however, remains a major issue which CHIC Partners hope can be overcome in the near future. Whilst the market price of a fuel cell bus has halved over the past 5 years to reach EUR 850 000, Madden says

a further halving of the price will be needed to generate serious commercial traction. 'Volumes of hundreds of buses are expected to reduce this price by another 25%, with further reductions arising from economies of scale and fuel cell vehicles sales in the passenger car segment. The new European wide coalition of bus operators and hydrogen bus and fuelling providers, which is led by the Fuel Cell and Hydrogen Joint Undertaking, should help create a sufficient critical mass to make this a reality.'

For potential clients, the main incentives to paying a premium lie in the environmental and operational benefits brought by fleets of fuel cell buses. These include better air quality, as only water is emitted at the tailpipe, negligible carbon emissions especially with hydrogen generated from renewable sources, and very low levels of noise. 'There is a trend towards the decarbonisation of transport with new regulations and mandatory targets, for example in Hamburg where authorities have

decided to purchase emission free buses only as of 2020,' Madden notes. 'CHIC has shown that fuel cell buses can offer a practical solution to decarbonising public transport — with a driving range allowing for a full day duty and short refuelling times — while also offering the same flexibility of operation, productivity and service quality as a diesel bus.

18 months to go

Although the team is happy with the project results — with buses hitting their technical targets and costs of production going down — it has been faced with reliability challenges which are being addressed. 'The availability of the vehicles has been below the project's target of 85%, and the relative immaturity of the technology leads to a slow parts replacement schedule — which is typical for emerging new technologies,' Madden admits. 'But a major programme aiming to iron out teething issues and improve maintenance procedures for what is still an immature supply chain has already helped bring availability up to the target level over the past months. It is now

hoped that the availability target will be met for the final 18 months of vehicle operations'.

With the objective of maintaining an 85% availability rate now being within the project's reach, only another 5% will be required to bring fuel cell technology to the level of availability of diesel buses. Madden notes this can only be achieved with the economies of scale expected thanks to next generation deployment projects.

In the meantime, local authorities keep showing more and more confidence in this innovative sector and the promise of a better future it holds for EU citizens. Noise and air pollution have become the main drawbacks of urban life, and fuel cell buses are a welcome solution to both.

CHIC

★ Coordinated by EVOBUS in Germany.

★ Funded under FP7-JTI.

★ http://cordis.europa.eu/project/rcn/97944_en.html

★ Project website:
<http://chic-project.eu>

★  <http://bit.ly/1HXtQdf>



CIRCULAR RUNWAYS MAY IMPROVE AIR TRAVEL

The idea of a circular runway for airports could help revolutionise air travel, shortening flight times, saving fuel costs and promoting airport efficiency.

The design of airport runways has remained largely unchanged ever since aeroplanes were created. However, the EU-funded project ENDLESS RUNWAY (The endless runway) has conceived a revolutionary design for a runway, based on a circular track that runs around the airport. Such a runway could enable planes to take-off in any direction and land from any direction, shortening trajectories, avoiding runway crossings and facilitating landings in any weather.

More specifically, the project team proposed a circular runway that would have a radius of 1.5 to 2.5 km, which enables changes to be

made to existing airports more readily. Such a runway would also be 400 m wide, striking a balance between limiting centrifugal forces and safety

considerations. Interestingly, several aircraft can operate on a 10 km runway such as this at the same time.

To achieve its aims, the project evaluated three operational models. The first was designed for low-wind scenarios where any part of the circle can be used in any direction. The second involved a high-wind scenario that was similar

to an airport with two parallel runways. The third model considered changing winds, and involved an aircraft sequence that gradually 'moves' with the wind direction.

With these scenarios in mind, the project team found that the concept could shorten take-off and landing tracks overall by 10% in comparison to straight runways. The model

"The concept could shorten take-off and landing tracks overall by 10% in comparison to straight runways."



fosters more sustainable operations that don't always rely on the wind, with total land use being smaller than that of conventional airports. While construction costs will be 10–60% higher, the concept offers benefits in terms of shorter trajectories, less taxi time and continuous capacity, ideal for increasing air capacity in the world.

ENDLESS RUNWAY has successfully demonstrated the feasibility of the circular runway project, highlighting benefits, future requirements and outlook. If Europe's airports shift to such a model, they could realise significant fuel savings and

streamline air travel. Exciting possibilities are in store for air travel in Europe.

ENDLESS RUNWAY

- ★ Coordinated by the National Aerospace Laboratory in the Netherlands.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/result/rcn/155366>
- ★ Project website: <http://www.endlessrunway-project.eu/>

WASTE HEAT FOR ROTORCRAFT POWER

Rotorcraft engines are becoming more electric for greater efficiency and safety. Powering these electrical systems with waste heat conversion will ensure sustainability.

The aerospace sector demands increasingly efficient engines to decrease fuel consumption and associated emissions. However, the latest rotorcraft engine technologies designed to meet the demand require more power than in the past.

Harvesting waste heat for electricity production can provide the additional power without hampering achievement of the original aim of sustainability. Scientists have now conducted a thorough analysis of the technical and economic potential and feasibility of waste heat recovery for rotorcraft within the scope of the EU-funded project RECYCLE (Thermal energy recovery electrical systems).

Work began with identification of all sources of heat loss in rotorcraft systems that could be exploited for electricity production. Scientists then reviewed the most innovative technologies worldwide to recover those losses. Technical performance was not the only consideration. Researchers evaluated the risk of potential solutions, including electrical and magnetic interference issues, structural integrity and flight safety.

The most promising candidates underwent a thorough analysis, resulting in detailed heat and power balance flow diagrams. A conventional Rankine cycle was chosen. Development of a rotorcraft power system simulator provided an opportunity to test the high-level system behaviour.

RECYCLE's systematic study of thermal heat recovery systems for electrical power generation from waste heat will pave the way to more sustainable and green rotorcraft. Advanced electrical systems for heating, cooling and monitoring will support more efficient engines. Offsetting their hunger for power with electricity from waste heat will ensure that sustainability is maintained.

RECYCLE

- ★ Coordinated by Pars Makina in Turkey.
- ★ Funded under FP7-JTI.
- ★ <http://cordis.europa.eu/result/rcn/154500>

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“Development of a rotorcraft power system simulator provided an opportunity to test the high-level system behaviour.”



ENVIRONMENT AND SOCIETY

ENZYME PROSPECTING IN THE LAND OF FIRE AND ICE

An EU-funded project has extracted enzymes found among Iceland's volcanoes that could lead to more efficient and greener industrial processes — from making food to biofuels. A number of these enzymes have already been patented, ushering in a new generation of natural catalysts for chemical processes and helping industry become more competitive.

Iceland's dramatic volcanic landscape continues to inspire and enthral locals, tourists and scientists alike and remains one of the best places on earth to study geothermal energy (heat energy generated and stored in the earth).

The beautiful terrain also happens to be teeming with microscopic enzymes tailored to cope with these harsh conditions. A group of EU-funded scientists wanted to discover whether some of these tough enzymes could be used to improve industrial processes that turn carbohydrates into consumer products.

Catalysing industrial competitiveness

Carbohydrates, which include complex sugars — or polysaccharides — such as starches, are very common molecules. They are widely used in the food industry but also find numerous applications in areas such as pharmaceuticals, construction, paints and biofuels. Enzymes perform a

crucial role in breaking down and synthesising these carbohydrate molecules.

'The underlying aim of the AMYLOMICS (AmylolEnzymes Captured by Targeted Metagenomics) project has been to help increase the economic growth and sustainability of European industry by improving the efficiency of these bio-conversion processes,' explains project coordinator Gudmundur Oli Hreggvidsson, a professor of microbiology at the University of Iceland and head of the biotechnology section at Matis, a biotech and food science company in Iceland. 'The technology developed in this project has enabled the rapid retrieval of novel gene-encoding enzymes from extreme resources, for a variety of uses.'

Progress has been impressive. In the space of just three years, a number of enzymes have been taken from discovery to full process development. These enzymes promise to be more efficient and thermally stable than conventional enzymes, potentially enabling higher operating temperatures

and thus greater solubility of polysaccharides for more complete reactions.

More than 4 500 novel gene-encoding carbohydrate-active enzymes were identified in this project, using the tools developed. From these, some 300 were extracted for further study, and about 200 cloned.

‘About 138 enzymes were then screened for industrial-relevant properties, with more than 50 candidate enzymes selected for application studies and detailed product analysis, including high yield production,’ says Hreggvidsson.

While only a fraction of the discovered enzymes could be investigated during the project, which ended in February 2014, the former partners are following up on several of these promising leads. Patent applications have been filed for five enzymes for use in the processing and modification of polysaccharides, while 15 new enzymes have entered the demonstration and marketing phase. One particular enzyme has since been developed and licensed to a small business for use in a recently developed bio-refinery process.

Environmentally responsible reactions

Over time, expanding the number of available enzymes for carbohydrate synthesis will also have a positive impact on the environment — replacing chemical processes with environmentally benign ones.

‘Europe has traditionally been strong in the application of enzymes for industrial processing of bulk carbohydrate biomass,’ says Hreggvidsson. ‘But to remain competitive, we need to provide a new generation of bio-based products. These biocatalysts we’ve discovered and developed have great potential to supplement or supplant decreasing fossil fuel-based resources.’

Ultimately, AMYLOMICS’ research will help to reinforce the sustainability of European starch and carbohydrate industries, and strengthen companies involved in enzyme discovery and development, he adds. Increasing the number of enzymes available should also result in new products coming onto the market.

“These biocatalysts we’ve discovered and developed have great potential to supplement or supplant decreasing fossil fuel-based resources.”

AMYLOMICS

- ★ Coordinated by Matis OHF in Iceland.
- ★ Funded under FP7-KBBE.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33916
- ★  <http://bit.ly/1DcVcu5>

NITROGEN AND SYMBIOSIS IN PLANKTON

Researchers in the EU have investigated how symbiotic marine microorganisms work together to harvest gaseous nitrogen into a form they can use.

This process is known as nitrogen fixation, and serves an important ecological function by channeling environmental nitrogen into the food web. A newly discovered group of

marine nitrogen fixers called diazotrophs work in symbiosis with other microorganisms called ciliates to fix nitrogen in the ocean.

The EU-funded SYMNIF (Evolution of symbiosis between ciliates and nitrogen-fixing prokaryotes) project aimed to investigate the symbiosis between diazotrophs and their hosts.

Over 100 different samples of ciliates (a type of zooplankton) were collected from the North Atlantic and tested for the presence of diazotroph symbionts. Almost half of the ciliates tested harboured a nitrogen-fixing symbiont.

Tests on five years’ worth of cultivated zooplankton showed that the

same diazotroph species was present in many different types of ciliate.

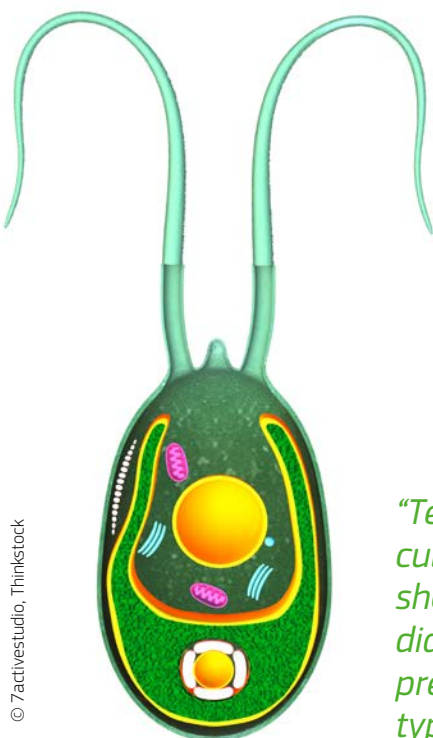
Samples collected in spring and summer showed more symbionts than during winter, likely due to nitrogen depletion in seawater over summer-time. However, adding nitrogen to growing zooplankton did not influence the nitrogen fixation rate, showing that the diazotrophs were not free-living species.

The SYMNIF project shed light on an important group of marine microorganisms for the first time. Understanding how these symbiotic microorganisms work together to trap nitrogen will help researchers better understand global nitrogen flows.

“Tests on five years’ worth of cultivated zooplankton showed that the same diazotroph species was present in many different types of ciliate.”

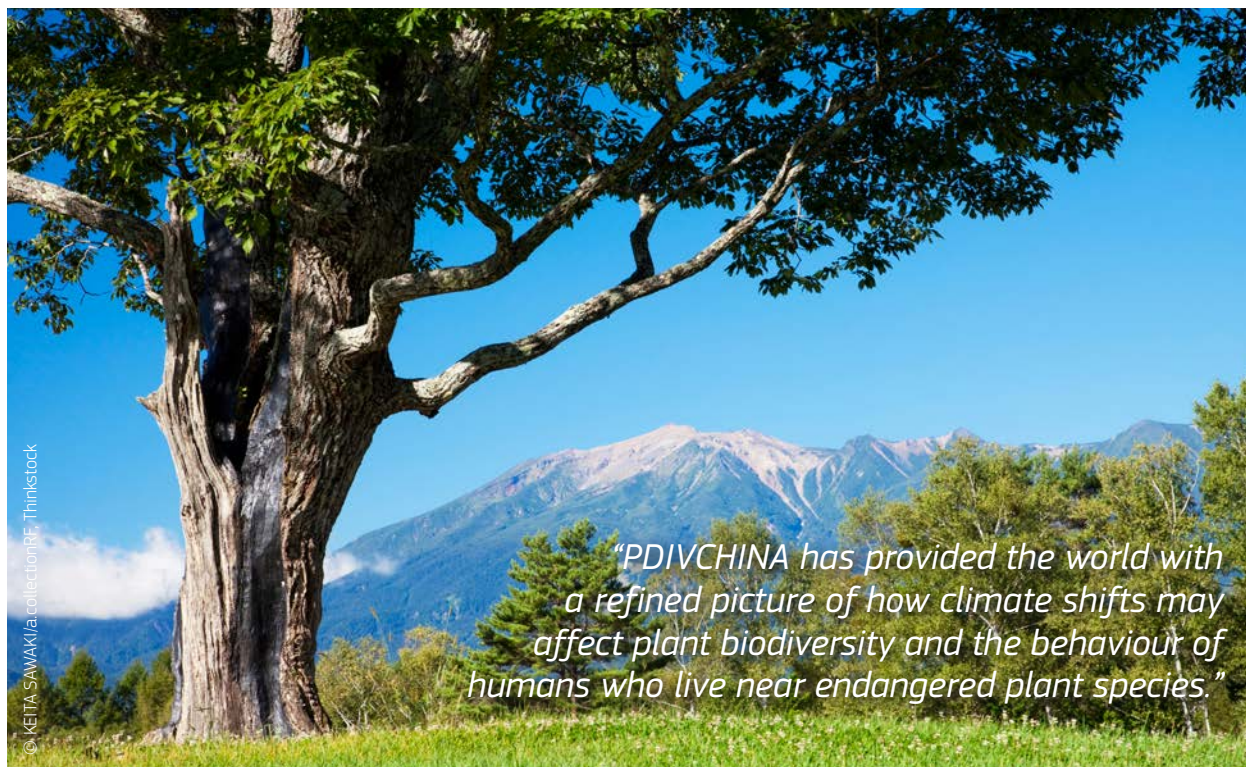
SYMNIF

- ★ Coordinated by the University of Copenhagen in Denmark.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155955>



RECONSTRUCTING A PLANT BIODIVERSITY TREE

Understanding the mechanisms that drive biodiversity and species richness is critical to plant conservation in the face of climate change. However, these mechanisms remain one of biology's great unsolved mysteries.



In the face of modern climate change, conservation depends on an understanding of what influences regional and global plant diversity. The plant biodiversity observed today is at least partially due to prehistoric climate patterns that influenced evolutionary history. And yet, questions remain regarding the large-scale biodiversity ramifications of ongoing climate shifts.

EU-funded researchers recognised that molecular and taxonomic relationships (phylogenies), compared with contemporary species distributions, could answer some questions. Working on the project PDIVCHINA (Plant biodiversity of China in a changing world: Evolution and conservation), researchers focused on massive datasets for the *Quercus* and *Rhododendron* genera.

PDIVCHINA's results suggest prehistoric factors affected modern *Quercus* and *Rhododendron* distribution. In particular, where species' ranges decreased, evidence of prehistoric influence increased. Similarly, the high diversity of *Rhododendron* species can be attributed in part to serious climate shifts in the late Eocene and early Oligocene.

Additionally, PDIVCHINA developed extensive phylogenies for woody plant families, along with genus-level phylogenies of 70 families. In analysing these evolutionary relationships, PDIVCHINA found explicit results. South-eastern China hosts the oldest species; moving northward, there is a trend towards younger species.

PDIVCHINA also mapped the species distribution of 7 680 woody plants. With these maps in hand, researchers

investigated how plants would respond to four distinct climate change scenarios. Intensive heterogeneity is most likely, and the Tibetan Plateau is likely to experience an advent of woody species, while southern China would lose these. Interestingly, PDIVCHINA predicted that phylogenetic diversity could be conserved at the family level, but species-level losses are to be expected.

Addressing contemporary conservation challenges, the researchers mapped China's biodiversity hotspots. They also assessed the relative phylogenetic diversity of China's endangered woody plants. PDIVCHINA then evaluated the socioeconomic and ecosystem services associated with woody plants within and outside the nation's natural reserves. The research team concluded that forest conservation is linked to rural poverty, and must therefore be included in rural development strategies.

PDIVCHINA has provided the world with a refined picture of how climate shifts may affect plant biodiversity and the behaviour of humans who live near endangered plant species. Such comprehensive awareness is essential for scientists and policymakers tasked with conserving China's natural heritage.

PDIVCHINA

★ Coordinated by the University of Copenhagen in Denmark.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/result/rcn/150764>

PHOSPHATE METABOLISM IN PLANTS

Researchers have investigated phosphate-transporting proteins in both plants and animals, in the knowledge that phosphate metabolism is key to modern agriculture.



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Phosphate-based fertilisers have revolutionised agriculture in modern times, allowing improved growth and maximising crop yield. However, phosphate run-off from fields is one of the major water pollutants in the world today.

Despite the importance of phosphates in agriculture, little is known about the mechanisms of phosphate import and export in plants. The EU-funded PHOSTASIA (Phosphate transport and signaling in Arabidopsis) project aimed to investigate the role of PHO1, a phosphate transporter and signalling protein in Arabidopsis thaliana.

The project began by determining the structure of PHO1 for the first time. This knowledge allowed researchers to create various mutated forms of PHO1 in order to better understand how the protein works.

Scientists also used genetic engineering to create an A. thaliana plant that grew normally despite having low phosphate concentrations in its shoots.

Another aspect of the project found that expression of the mammalian PHO1 orthologue XPR1 in tobacco leads to exporting phosphate out of cells, making it the first phosphate exporter identified in mammals.

PHOSTASIA has advanced our knowledge of phosphate transport in both plants and animals. This will ultimately contribute to the sustainable use of phosphate in agriculture.

PHOSTASIA

- ★ Coordinated by the University of Lausanne in Switzerland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155944>

WHY FISH STAY OR GO IN WINTER

Researchers have advanced our understanding of partial migration in a common fish species.

During winter, roach fish (*Rutilus rutilus*) migrate from lakes to streams, but some members of the population remain behind. This phenomenon, which occurs widely in the animal kingdom, is called partial migration.

As part of the EU-funded STAY OR GO (Partial migration: Individual causes and population genetic consequences) project, researchers studied the causes and effects of partial migration in roach.

“Residents had a significantly higher probability of being predated upon by cormorants, but migrants sacrificed food for safety in streams.”

They found migratory strategies to be highly consistent: some individuals tended to migrate every year, while

others (termed residents) rarely migrated. The destinations and timing of migrations were also consistent.

Researchers investigated whether or not fish migrate to avoid predators in winter when food is low. They indeed found that residents had a significantly higher probability of being predated upon by cormorants, but that migrants sacrificed food for safety in streams.

They also determined that fish with bold personalities are more likely to migrate than shy fish, and that migratory fish have a different feeding niche to

residents. In addition, fish from lakes offering the possibility to migrate (via connected streams) are on average more fusiform in body shape than fish from isolated lakes.

STAY OR GO findings have significantly advanced our understanding of the important ecological process known as partial migration. Further work will focus on whether or not migrants and residents breed with one another.

STAY OR GO

- ★ Coordinated by Lund University in Sweden.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155973>



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CHEAP NEW CATALYSTS TO CLEAN WASTEWATER

Scientists have developed and tested a number of new catalysts that use 'ultraviolet' (UV) or visible light to break down common environmental pollutants.

Water pollution from industrial wastes is a worldwide problem. In particular, organic compounds such as phenol and biomass waste products like cellulose can cause long-term environmental problems if not dealt with.

The EU-funded PHOTOBIO23JC project addressed this problem by developing photocatalysts — chemicals that break down organic compounds through the power of UV or visible light.

PHOTOBIO23JC developed several novel photocatalysts and tested them against the current industry-standard photocatalyst Evonik-P25. An important feature of the newly developed compounds is that they can function at normal environmental temperature and pressure.

One photocatalyst in particular was better than Evonik-P25 at breaking

down phenol, yielding valuable by-products like gluconic and glucaric acid. Others were much cheaper than their current commercial counterparts.

Biological safety is extremely important in this field, and the catalysts of PHOTOBIO23JC performed well in this regard. They left no residue of heavy metal atoms, and could be easily and quickly recovered from treated water.

The PHOTOBIO23JC project produced photocatalysts cheaply and simply. The

photocatalysts show better and more specific activity than the current state-of-the-art. These results may lead to more cost-effective and more efficient cleaning of contaminated wastewater.

PHOTOBIO23JC

- ★ Coordinated by the Institute of Physical Chemistry at the Polish Academy of Sciences in Poland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155886>



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THE CLIMATIC ROLE OF AEROSOLS

An EU study has worked to determine the role of atmospheric aerosols in climate processes. Satellite data show the distribution of atmospheric particle sizes, facilitating constant monitoring, the issuing of warnings and better understanding of the dynamics at play.

Aerosols are small particles suspended in the air, and can be of either natural or man-made origin. They play a significant role in climate change, however the exact extent is unknown.

The issue is an international research priority, with the EU funding the two-year AEROMAP (Global mapping of aerosol properties using neural network inversions of ground and satellite based data) project to investigate it. The key question was how aerosol quantities and compositions vary around the globe and over time, which the project addressed using daily whole-Earth satellite maps. The goal was to subdivide the globe into distinct aerosol types, and to show the distribution of particle sizes in the atmosphere.

Additionally, the project tested the feasibility of conducting global real-time aerosol monitoring. The team further considered constructing an air quality index to assess climatic risks and issue alerts regarding aerosol impact. The project wound up in early 2014.

AEROMAP developed and validated new data mining tools, based on cluster analysis and neural networks. The tools convert satellite data into aerosol microphysical properties for various globally distributed aerosol types. The near-daily maps are used to monitor and classify aerosols as they move about the Earth.

Concerning the feasibility studies, AEROMAP determined that the average global distribution of aerosols can be separated into 10 distinct regions, each having a particular composition. Neural network models analysed eight years of daily data for each

region. The models were validated in terms of being able to retrieve aerosol microphysics.

Hence, the project produced global maps showing size distributions of atmospheric aerosols, used to monitor the evolution of atmospheric events. It was not previously possible to observe the evolution of such events, especially over large uninhabited areas such as deserts or oceans. The study also created the first near-daily maps of global air quality produced from aerosol microphysics rather than chemistry. The team developed two indices showing the potential impact on health and visibility.

The research resulted in two conference presentations and four journal papers.

AEROMAP provided a new understanding of the dynamics of atmospheric aerosols, an important factor in climate change. The project enabled the use of satellite data to create almost-daily whole-Earth maps of aerosol properties and their effects.

"The project produced global maps showing size distributions of atmospheric aerosols, used to monitor the evolution of atmospheric events."

AEROMAP

- ★ Coordinated by the National Observatory of Athens in Greece.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155894>

IT AND TELECOMMUNICATIONS

SAFE PUBLIC INFRASTRUCTURE... FOR LIFE!

European researchers have developed a wireless sensor system to monitor the safety of large infrastructure. The new system will not only potentially save lives when the structure is old, but also reduce costs during construction.

Building structures can be affected by earthquake, landslides or construction defects from a previous era. But collapses in infrastructures, sometimes tragically resulting in deaths, can be avoided in future if early-warning sensors are placed on them right from the start.

The challenge of safeguarding major infrastructures — especially those used intensively by the public, such as bridges or historic monuments — led researchers in the EU-funded GENESI (Green sEnsor NEtworks for Structural monitoring) project to design a 'Wireless sensor network' (WSN) for monitoring structural health.

'You want sensors to work for the whole lifetime of the structure, which could be tens or hundreds of years,' explained coordinator Professor Chiara Petrioli, of La Sapienza University in Rome. 'This was the technical challenge before us. But we also found we could deploy the sensor networks in construction works, to make design amendments if necessary and safeguard workers on the project.'

Compared to existing technology, GENESI's sensor networks are non-intrusive and cheap to deploy and maintain. Being battery-driven, they are also suitable for remote areas with no electricity supply and can be used when the power grid is down, such as after an earthquake.

Rome's metro and a Swiss road bridge

The technology was validated at two construction sites: the new B1 metro line in Rome, and the Pont de la Poya bridge in Fribourg, Switzerland.

In the metro, concrete segments of the tunnel final lining, instrumented with GENESI sensors, were deployed directly next to the 'Tunnel-boring machine' (TBM) to measure parameters such as strain, temperature and deformation in real time.

The data was fed back via proprietary low-power protocols, 3G and internet to a control and alarm panel supervised by engineers and geologists working on the project. These professionals were able to check if the drilling was being performed with the safety of workers and passengers in the metro foremost in mind.

The network is simpler, quicker and cheaper to install and maintain than traditional cable-connected sensor systems and, in pursuit of long-lasting, energy-efficient monitoring of the tunnel when in operation, it is partly powered by micro turbines spinning in the gusts of passing trains.

During construction of the Swiss bridge, around 25 sensors measured parameters such as pull on the pylons, bearing displacement and wind, temperature and water levels.

'It proved very useful, because there are always a lot of uncertainties in design, planning and construction,'

said Holger Wörsching, an engineer with Solexperts AG, a Swiss measurement company and partner in GENESI. 'When the bridge was shifted to connect to both sides, we got feedback on deformation and bending and could check the loads were right.'

Other applications

Solexperts sees many opportunities for the technology and is now also deploying it in an access tunnel for a hydro plant in Innertkirchen and an Alpine railway line vulnerable to landslides.

A GENESI spin-off company (Wsense), employing six people, is also exploring the deployment of a miniaturised version of the GENESI system to monitor Italy's many public heritage sites. Wsense is helping the country's Ministry of Cultural Heritage with another, previously-unimagined application: the precarious task of transporting artworks between museums.

FP7 has invested in GENESI to the tune of EUR 2 million. The project ran from April 2010 to August 2013 and involved seven partners in four countries.

GENESI

- ★ Coordinated by the Sapienza University of Rome in Italy.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/result/rcn/157634>
- ★ Project website: <http://genesi.di.uniroma1.it/>
- ★  <http://bit.ly/1La589x>

A NEW AGE IN CONCURRENT COMPUTING

Major advances in concurrent computing and transactional memory promise to take simplicity of parallel programming and computing speeds to the next level.

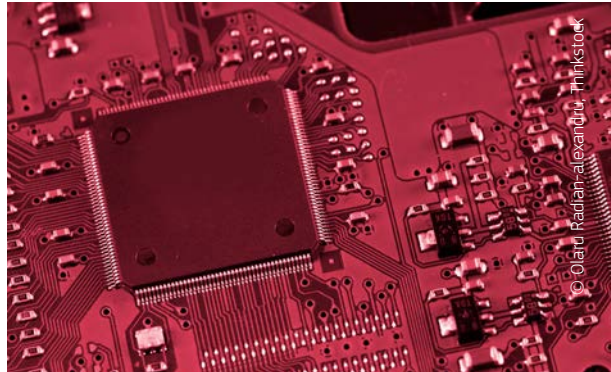
As major chip manufacturers have migrated from increasing the speed of individual processors to putting several processors on the same chip, a new software revolution — known as the concurrency revolution — has emerged. In this context, the EU-funded project TRANSFORM (Theoretical foundations of Transactional Memory) investigated ‘transactional memory’ (TM), a new programming paradigm that is widely considered the future of concurrent programming.

The project brought together leading researchers in the field to define a modern theory of concurrent computing. The TRANSFORM network is comprised of leading stakeholders from France, Germany, Greece, Israel, Switzerland, the United Kingdom and the United States.

Together, the project partners greatly advanced the theory behind the design and analysis of TM systems. More specifically, the network studied the semantics of TM systems and built a common framework to design and compare TM algorithms. It formulated correctness and progress criteria for such systems, and introduced suitable complexity metrics. Project work also involved designing and testing the implementation of TM systems, including key software structures such as shared data structures. This was in addition to outlining the inherent limitations of such systems.

Importantly, TRANSFORM extended top-notch education to 12 early-stage researchers who helped advance the project significantly and gained invaluable experience in the process.

Overall, TRANSFORM conducted fundamental research that could further improve concurrency in the future.



The project's research results are notably already being considered a point of reference for designing and analysing concurrent algorithms. The emerging research has shed light on key issues regarding the design and analysis of TM systems, facilitating their widespread adaptation in the production of concurrent software.

The project has led to the formation of a strong cooperation network among academia, research organisations and industry. This will help users exploit the available computational power that multi-core processors offer now and in the future. Thanks to these efforts, the next generation in concurrent programming is clearly on the horizon.

TRANSFORM

- ★ Coordinated by the Foundation for Research and Technology Hellas in Greece.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155986>

INTERNET LINKS REVEAL PATTERNS OF INTERACTION

How can we make predictions of people's activities based on internet links? What can we learn from patterns of usage on the internet? The EU's NADINE project is establishing algorithms and methods of analysing activities online that will shine a light on relationships between subjects, countries and even trading commodities.

The internet is currently made up of around 50 billion pages, all linked together to form a vast, virtual landscape. Our interaction provides data which, when broken down and analysed, can help us understand a wide range of human activities, from the cultural to the economic.

Funded by the EU's FP7 under the Future and Emerging Technologies scheme, the NADINE (New tools and Algorithms for Directed Network analysis) project is contributing to the development of new types of search engines, putting Europe in the lead in this important area.

‘We are trying to map the net to show how pages are linked together and how people use these links in their voyage around the net,’ says NADINE project coordinator, Dima Shepelyansky, research director at the Laboratoire de Physique Théorique, CNRS Toulouse.

The project uses tools, including those provided by Google, to show how pages are linked together. Doing so can, for example, show the probability of people visiting certain sites, making particular choices, buying particular items or voting in certain ways.

Refining ways of tracking online interaction

To develop and test their methodologies, researchers looked at Wikipedia biographical entries to see if they could rank the people referred to in order of influence. They analysed the 24 major languages, and considered the number of articles linking to the

“We have been developing a new way of analysing the commercial exchange of 61 products across the UN countries.”

individuals using Google's PageRank system which says a page is important if important pages link to it.

But this threw up an interesting problem for the project to iron out — the scientist Linnaeus appeared to be the most important individual. Since he was responsible for classifying organisms, there are links to his page on every Wikipedia page referring to plants and animals, resulting in skewed results.

So researchers decided to introduce CheiRank, which describes the importance of a page in proportion to the number of outgoing links. By combining both, researchers were able to establish a robust way of measuring importance. Self-organising, hyperlinked web communities can also be detected using the methods developed.

Online information flows similar to commercial exchanges

Considering the way links to and from a page can show how information is exchanged, the project then applied their findings to the analysis of commercial flows. NADINE has been using the United Nations' world trade database, which gathers data from the last 50 years. 'We have been developing a new way of analysing the commercial exchange of 61 products across the UN countries, determining the sensitivity of trade balance to price variations', Shepelyansky explains.

NADINE brings together a partnership of theoretical physicists, mathematicians and computer scientists from France, the Netherlands, Hungary and Italy. 'Transnational EU funding was

indispensable when it came to getting a team of scientists from such a variety of disciplines together,' he adds.

The project has been running for three years and ends this April (2015). It is supported by nearly EUR 1.223 million in EU funding. Now that it has the methodology clearly established, researchers from the NADINE consortium intend to continue the work with various partners including the World Trade Organisation.

NADINE

- ★ Coordinated by CNRS in France.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/result/rcn/156020>
- ★ Project website: <http://www.quantware.ups-tlse.fr/FETNADINE/>

INCREASING PUBLIC SAFETY

The rise in deliberate threats against Europe and its citizens necessitates the widespread use of public surveillance cameras and other monitoring tools. An EU initiative has developed cutting-edge automatic detection technology to better protect people, as well as public and private property.



© Izabela Zaremba, Thinkstock

Modern video surveillance equipment fails to detect hostile or threatening activity in crowded areas before an incident or attack. What is more, operators responsible for observing countless hours of real-time footage or analysing post-event footage are often subject to human error.

Thanks to the EU-funded project ADABTS (Automatic detection of abnormal behaviour and threats in crowded spaces), an automated detection system was designed to offer a

more effective, accurate and cost-effective alternative to manual surveillance.

The team started out by creating models for various kinds of

threats and for abnormal behaviour at an airport, stadium and town centre. It devised techniques for detecting these threats and signs of unusual behaviour in video and audio surveillance data.

Today's surveillance systems cannot effectively distinguish between normal and uncharacteristic, possibly threatening behaviour of masses or individuals, particularly prior to a harmful or destructive event.

Researchers developed and tested visual and acoustic sensor processing and inference mechanisms that enable long-term monitoring of the location and behaviour of people close to an acoustic event. These include gunshots, breaking glass, screams and offensive songs.

The sensors, algorithms and user interface work together to deal with problematic, crowded scenes, including tracking movement and flow patterns of multiple people, and recognising unusual sounds and then categorising them accordingly. In combination, these will be able to automatically reject the majority of recorded footage and retain only suspicious events.

ADABTS will help security stakeholders in their fight against crime, terrorism and rioting through early detection and alerting of potential threats. For European citizens, this ultimately means that they will feel safer in public.

ADABTS

- ★ Coordinated by the Swedish Defence Research Agency in Sweden.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/result/rcn/155989>
- ★ Project website: <https://www.informationssystemsfors.se/?subpage=/projectweb/45f7d623ad7ff/index.html>

"The sensors, algorithms and user interface work together to deal with problematic, crowded scenes."

INDUSTRIAL TECHNOLOGIES

FINDING THE SENSOR BEHIND THE SPARKLE

Diamonds — highly desirable lumps of carbon. But while their use to jewellers is well known, their hidden secrets are being revealed by the DIADEMS project. By modifying the structure of a diamond crystal, the project creates a new material that could be used in applications, from the creation of smart medicines to the next-generation computers. This EU project is helping Europe stay at the forefront of research into atomic-scale sensors.

The EU-funded DIADEMS (DIAMond Devices Enabled Metrology and Sensing) project is replacing a single atom in a diamond crystal with one of nitrogen; this is known as 'doping'. By trapping nitrogen in the crystal, researchers can produce an atom-like structure with intrinsic magnetic properties obeying quantum mechanics.

'This means that we can ultimately create tiny sensors that detect small magnetic signals. For example, these magnetic signals would allow us to monitor the electrical activity of neurons on a diamond slide and see how they operate together,' explains Dr Thierry Debuisschert, project coordinator of DIADEMS, based at Thales, France.

'In the future, we may be able to see whether or not a neuron is responding to a chemical being used for treatment.' This outcome would benefit research into neurodegenerative diseases such as Alzheimer's.

Life sciences, physics, chemistry — wherever magnetic fields play a role, DIADEMS' work could make a difference.

A world of applications opening up

The innovative ability to see how molecules react by reading changes in the spin of their electrons means researchers will be able to analyse exactly what is happening in chemical reactions at molecular and atomic scale.

'A wide range of applications start to appear because we are able to monitor so precisely,' says Debuisschert.

Computing could benefit too, as the sensors can be used in the development of small, high-density storage discs with far greater capacity and reliability.

'The capacity of data storage discs is getting ever bigger, squeezing the size of the magnetic domains used to store the information. By working at the atomic and molecular level, we could be able to control those storage devices at the scale required for high-density storage,' he adds.

Results for research

Debuisschert is fascinated by the combination of atomic physics and quantum mechanics and how it can yield practical applications. 'We are in an industrial context, so we have to show that there are real, marketable applications at the end of the research.'

The fact that DIADEMS is using lab-grown diamonds working at room temperature means once ready, its technology will be easier to apply and market. 'Even so,' says Debuisschert, 'since we are still at a research level, EU funding at this stage is indispensable.'

The benefits of working at EU level

While the project would not exist without the EU funding, Debuisschert feels a particularly important aspect of an EU-wide project is the collaboration between the 15 partners with a mix of academic and industrial partners. 'We can be directly informed of all recent results coming out of EU labs, which saves a lot of time, and we can share ideas in a way that is specific to European projects,' he explains.

'This helps us stay competitive in comparison with the big competitors abroad.'

The project, which runs for four years, kicked off in September 2013. It is backed by EU support, via the Future and Emerging Technologies scheme, to the tune of EUR 6 million.

DIADEMS

- ★ Coordinated by Thales in France.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/result/rcn/156015>
- ★ Project website: <http://www.diadems.eu>

SINGLE NANO-SCALE EMITTERS IN SEMICONDUCTORS

Interactions of light and matter form the basis of numerous phenomena and novel devices. With their one of a kind experimental setup, scientists have produced pioneering results with ultra-short coherent light bursts in semiconductor nanostructures.

Ambitious EU-funded researchers set out to explore quantum interactions within the scope of the project SUPERRAD (Demonstration of superradiance in a semiconductor nanostructure). Despite obstacles related to high equipment costs and unavailability of high-purity samples,

by completion the team had achieved world-class results.

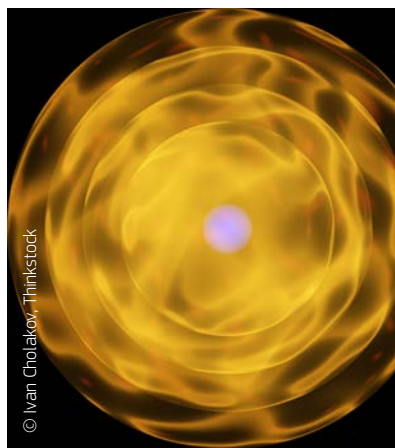
The scope of the project turned toward coherent non-linear spectroscopy, significantly advancing the current state-of-the-art and delivering groundbreaking outcomes regarding individual emitters in solids.

Scientists developed a novel spectroscopic technique using short optical pulses from three beams. The pulses resonantly drive a non-linear response in single excitons (a dipole moment created by an electron-hole pair) in strongly confined quantum dots. The setup performs much better than the previous generation, until recently available in only one lab in the world.

With it, the team carried out seminal experiments on single excitons using four-wave mixing and six-wave mixing protocols exploiting the interaction of four or six coherent optical fields.

Researchers were able to dramatically enhance the retrieval efficiency of coherent responses of single quantum dots in semiconductors. Quantum information processing relies on coherent and reversible mapping between light and matter, so this is of great significance.

Numerous publications in prestigious peer-reviewed journals, including *Nature Materials*, *Nature Communications* and *Nature Photonics*, have highlighted the work. The technique opens the door to exploration of numerous materials and behaviours, including the spatial propagation of coherence, and has established the project head as a leader in the field.



SUPERRAD

- ★ Coordinated by CNRS in France.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155870>

SIMPLE SYNTHESIS OF NOVEL NANOMATERIALS

Metal oxide and metal sulphide nanoparticles are promising materials for catalysis, sensing and optoelectronics. Simple, well-controlled and cost-effective synthesis methods for a variety of such materials will create new markets.

Scientists produced and characterised a variety of metal oxide and metal sulphide nanomaterials with EU funding of the project HYBRID NANOMATERIALS (Development of hybrid nanostructures for photocatalysis and fuel cell applications). Work resulted in five publications in peer-reviewed scientific journals.

The team demonstrated simple one-step synthesis of a number of metal oxide nanomaterials from single-source precursors using thermal decomposition. Products included close-packed films of copper nanocrystals, copper oxide nanoparticles and porous manganese oxide nanowires. Similarly, varying reaction conditions led to control over shape and production of iron oxide rectangles and belt-like structures, cobalt oxide nanofibres and tin oxide nanowires.

Researchers also produced several metal sulphide nanostructures with thermal decomposition of a single-source precursor. These included tin sulphide nanowires and a hybrid 'cadmium sulphide' (CdS)–'zinc oxide' (ZnO) structure. For the latter, a vertically aligned ZnO nanowire array was filled with CdS.

Ultra-thin tungsten oxide nanowires have shown promise for numerous applications in sensing, solar cells and electrochromic devices that use voltage to control optical properties. Scientists produced and characterised solution-phase

nanowires. They then deposited them on 'indium tin oxide' (ITO) with an eye on electrochromic devices.

Nanowire synthesis enabled independent control over length and diameter by varying the three reaction components and the reaction conditions. The films on ITO showed promising optical properties and stability, opening the door to development for use in display applications and smart windows.

Finally, researchers successfully synthesised hybrid nanostructures of metal–ZnO nanopillars in which the metal can be attached either to the base or the tip. It is the first report of nanopillars employing copper or silver with ZnO.

Producing controlled architectures at the nano scale is no simple task. However, HYBRID NANOMATERIALS has successfully accomplished it in simple processes, synthesising a wealth of nanomaterials with important industrial applications. The technology should reduce processing time and cost while enhancing product reliability, in turn supporting a competitive EU nanotechnology sector.

HYBRID NANOMATERIALS

- ★ Coordinated by Ben-Gurion University of the Negev in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155861>

POWERING UP TRANSISTORS

Most modern computers are run with transistors, but they are now reaching their physical limits. An EU initiative looked into the power savings and performance enhancement of transistors.

Power loss is a key issue as semiconductor devices and circuits approach the limitations of scaling. Alternative transistor and memory designs are therefore needed to enhance speed and power consumption. There is a growing need to decrease the power consumption of logic devices — chips that provide some sort of processing capability.

The EU-funded TETTRA (Towards enhanced III-V tunnel transistors) project examined whether tunnel 'Field-effect transistors' (FETs) can be run with less power, which will then allow them to run faster.

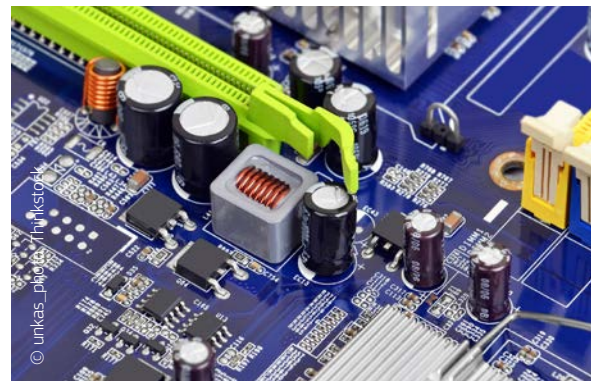
Tunnel FETs are one of two major categories of transistors that use an electric field to control the shape and therefore the conductivity of a channel of one type of charge carrier in a semiconductor material.

The choice of materials is key to enabling a reduction in voltage supply and a path to lower system power. Scientists analysed the use of nanowires and certain types of semiconductor materials in improving tunnel FET performance.

Project members examined band-to-band tunnelling, which offers smaller voltages and power reduction. The surface properties of tunnel FETs are considered important for performance. As such, the partners assessed the surface properties of the nanowires and the semiconductor materials.

Lastly, scientists designed and validated an innovative technique for analysing the electricity production of nanowires.

Work on TETTRA has indicated that considerable power savings can be obtained by using low-voltage tunnel FETs. The prospect of lowering the power



requirements of next-generation transistors is very real.

TETTRA

- ★ Coordinated by IBM Research in Switzerland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155857>

NEW TECHNOLOGY FOR THE CONCRETE INDUSTRY



Concrete construction is expensive — mostly because of the formwork, which can be up to 75% of the costs. This project developed an industrialised process for producing unique, tailor-made concrete structures using a new and cost-effective approach.

The concept involved both on-site and prefabricated elements and both load-carrying and facade elements. The EU-funded project TAILORCRETE (New industrial technologies for tailor-made concrete structures at mass customised prices) combined the knowledge resources of architects, designers, concrete technologists, civil and structural engineers, and robot experts.

To enable a seamless data flow from file to factory, a digital design tool was developed. This technology for casting concrete using robotics replaced the use of traditional formwork, enabling greater flexibility in producing singular concrete structures with different geometric designs.

TAILORCRETE transitioned from rectangular form construction to new industrialised production of unique concrete structures without the need for expensive and labour-intensive manual construction processes. A crucial factor for the casting of complicated structures is the availability of self-compacting concrete. This material allows all corners of the formwork to be filled without vibration.

Weaknesses of the project included the physical separation of some collaborating partners. Also, some system and technologies require high investments in order to achieve certain production capability to ultimately improve cost efficiency in production.

Project results were widely disseminated. This was achieved through participation in seminars and conferences, scientific papers and trade magazines, a website, a private industry group and an informational brochure.

The project achieved a balance between, on one side, research and innovation capability and, on the other side, industrial knowledge and application experience. All results have been validated in full-scale use cases, with solid conclusions compiled on their potential exploitability or necessary improvements.

TAILORCRETE

- ★ Coordinated by the Danish Technological Institute in Denmark.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/155859>
- ★ Project website: <http://www.tailorcrete.com/>
- ★ <http://bit.ly/1B55X2x>

SPACE

EXPLORING THE POTENTIAL OF NEW ORBITS FOR FUTURE SPACE SERVICES

Space exploration may one day reveal clues to the origin of the universe and life on Earth. In the meantime, scientific advances in the field have supported 'space services' for everyday life such as weather forecasts and satellite navigation on our phones. With his ERC grant, space engineer Prof. Colin McInnes explored the mathematics of new families of orbits around the Earth for spacecraft, from micro-satellites to large solar sails. The objective was to map these orbits and to uncover potential applications for new space technologies in fields as diverse as space science, Earth observation and telecommunications.

'Space has a huge impact on our lives,' says Prof. McInnes, 'but it is invisible to us. It is amazing to think that a technology such as satellite navigation which 30 years ago was only available to the military is now embedded in our smartphones and available at the touch of a button. When we look at a map on our phones using satellite navigation, the locational point is the top of a pyramid which stretches right back to the rocket which launched the satellites into space.' Space technology is now harnessed for a wide variety of civilian uses — telecommunications, monitoring crop growth, urban development and climate science.

At the Advanced Space Concepts Laboratory, Prof. McInnes' team has used an ERC Advanced Grant to explore the potential of various orbits, both close to and far from Earth, to support future space products and services. They used mathematical modelling to understand how natural forces such as light pressure from the sun can generate new families of orbits, for example using the

pressure of sunlight on a large reflective sail to hover stationary over the poles of the Earth for climate science observations.

Capturing asteroids

Prof. McInnes' fascination with space began as a young child gazing at a picture of a rocket on his Junior School classroom wall. Add to this an inspirational physics teacher at High School demonstrating projectile motion, and he was hooked. Through the VISIONSPACE (Visionary Space Systems: Orbital Dynamics at Extremes of Spacecraft Length-Scale) project, his team also investigated 'Near Earth Objects' (NEOs) — asteroids or comets in orbits close to the orbit of Earth. The team has looked into how they could exploit the natural effects to manipulate the orbits of NEOs, ultimately to engineer some of them for capture on Earth and exploitation for future in-space resource use.

In the course of the project, the team discovered a new class of easy-to-capture asteroids that could be mined for raw materials in the future to support future space ventures. Within a catalogue of 10 000 space objects, the researchers identified a new

“The team discovered a new class of easy-to-capture asteroids that could be mined for raw materials in the future to support future space ventures.”

category of ‘Easily retrievable objects’ (EROs) and 12 fairly small asteroids, ranging in size from approximately 2 metres to 60 metres in diameter, which could be captured with existing space technology. Applications include baking water out of small

asteroids using heat from the Sun to provide resources for future human space exploration.

The researchers also recently calculated ways to use so-called ‘sticky’ orbits, where the asteroid is not

strictly captured but would remain at an accessible distance from the Earth. Their method, yet to be developed and put to the test, could be cheaper than others currently considered by space agencies.

The freedom to think

Prof. McInnes describes the ERC funding as ‘a fantastic opportunity and essential to the health and wellbeing of the European research base because it is the only funder which is supporting unconstrained frontier research in this way.’ In the context of his

five-year VISIONSPACE grant, it meant that the team was encouraged to pursue curiosity-driven research, not least because they were freed from the need to regularly re-apply for funding.

The funding led to the establishment of a new Space Institute at the University of Strathclyde, a regional Centre of Excellence in satellite applications and strong links with Glasgow-based CubeSat manufacturer Clyde Space Ltd. It also gave the research team the time and space to explore unexpected ideas, such as applying prior research by astronomers on the orbits’ interplanetary dust to design new ways of removing space debris, such as old satellites or spacecraft fragments, ultimately ‘cleaning space’.

Since finishing his ERC project, Prof. McInnes has moved to the University of Glasgow, where he is James Watt Chair, Professor of Engineering Science, and hopes to bridge the forthcoming centenary of his Chair with the intellectual possibilities of science and engineering of the next hundred years — further opening the ‘envelope of possibilities for our future’.

VISIONSPACE

- ★ Coordinated by the University of Strathclyde in the United Kingdom.
- ★ Funded under FP7-IDEAS-ERC.
- ★ <http://erc.europa.eu/projects-and-results/erc-stories/exploring-potential-new-orbits-future-space-services>

PLASMA KINETICS IN SPACE

Space plasma makes up more than 99% of the visible universe, including near-Earth regions such as our magnetosphere. Exploiting spacecraft data and powerful computing, scientists have discovered new plasma phenomena of relevance to space weather.

When a gas is incredibly hot, some or all of its atoms are split into electrons and positively charged ions that can move around independently of one another. This ionised gas is called plasma, the fourth phase of matter in addition to solid, liquid and gas. It is an interesting mix of charged and uncharged particles, and electrical and magnetic fields.

The Earth’s magnetosphere and the particles accelerated in it play an important role in space storms and space weather in general. These, in turn, can have effects on orbiting satellites and their function. The EU-funded project GEOPASMAS (Dissipative structures and kinetic processes in the near Earth plasmas) was initiated as an exchange programme by a consortium of five research institutions.

Scientists set out to study heating, transport, acceleration and interaction processes in near-Earth plasmas. Research led to many new discoveries that will be important for science policymakers given the impact on space weather and space weather forecasts. In addition, insight into near-Earth plasma from space exploration can be

an invaluable tool to draw inferences about other plasma that can only be studied remotely.

Prolific and stimulating collaboration led to more than 235 publications in peer-reviewed scientific journals as well as over 50 presentations at international conferences. Strong collaborations and ties established among young researchers from the five institutions, eight of

whom were women, should ensure a lasting legacy of exploration into space plasmas.

GEOPASMAS

- ★ Coordinated by the University of Calabria in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/155871>



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SCHRODINGER'S CAT IN SPACE

An exciting EU-funded project has focused on the conflict between quantum mechanics and Einstein's General Theory of Relativity. Scientists are now ready to launch their protocol into space, hoping to witness the macro-scale transition from classical to quantum.



The project QOFES (Quantum optomechanics for fundamental experiments in space) investigated the regime between the classical and the quantum world by exploiting the microgravity environment of space.

Newton's famous Laws of Motion, the foundations of classical mechanics, are completely deterministic and based on studies of macroscopic objects. Knowing the position and velocity of a particle at any given time, one can calculate all past and future positions.

A couple hundred years later, Schrodinger's wave equation for matter accounted for observations relating to the dual particle-wave nature of light and matter. It describes a particle's trajectory as a probability density and forms the basis of quantum mechanics.

Quantum mechanics and Einstein's General Theory of Relativity conflict when it comes to the former's concept of superposition. Quantum mechanics says an object can be in two states at once but relativity says an object is forced to adopt one state or another. Quantum theory has been well-tested and confirmed with great accuracy on the smallest scale with photons where gravity is non-negligible. It must be shown with more massive objects to be generally true.

QOFES set out to make it happen. Scientists developed a protocol, the MAQRO proposal, to test quantum superposition in space. It exploits nanospheres levitated in optical

trapping potentials and the microgravity environment of space. The experiment enables testing of objects on a more massive scale. It also eliminates the confinement of mechanical support of the object and facilitates an environment where gravity is non-negligible.

The proposal itself, together with theoretical investigations of feasibility, definition of technical requirements and results of first proof-of-principle experiments have led to six publications so far and widespread public interest. Most recently, an international MAQRO consortium was formed to prepare the official MAQRO proposal for funding from the European Space Agency's (ESA) Cosmic Vision programme.

QOFES has paved the way for what may be some of the most important experiments in physics. Work has also solidified the leading role of Europe in space experiments that will reveal the fundamental physical nature of the Universe.

QOFES

- ★ Coordinated by the University of Vienna in Austria.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/154438>

EVENTS

APRIL
28 ▶ 29

Ankara, TURKEY

CONFERENCE

2015 INTERNATIONAL CONFERENCE ON AUTOMATIC CONTROL (ICOAC 2015)

The 2015 International Conference on Automatic Control (ICOAC 2015) will be held from 28 to 29 April in Ankara, Turkey.

Organised by the American Society for Research (ASR), the conference is an international forum for the presentation of technological advances and research results in the field of Automatic Control. The organisers welcome previous and prospective authors who are encouraged to submit new research papers to ICOAC 2015 by 5 March. Accepted papers will be published in the Applied Mechanics and Materials Journal (ISSN: 1660-9336).

Registration fees for the conference range from approximately EUR 310 to approximately EUR 490.

For further information, please visit:
<http://www.icoac.org/index.html>

MAY
04 ▶ 05

Athen, GREECE

CONFERENCE

INTERNATIONAL CONFERENCE ON INFORMATION SYSTEMS, COMPUTER ENGINEERING AND APPLICATIONS (ICISCEA 2015)

The International Conference on Information Systems, Computer Engineering and Applications (ICISCEA 2015) will take place from 4 to 5 May in Athens, Greece.

ICISCEA 2015 will present recent scientific research in the field of information systems and its impact on performance. The event will promote information systems that inspire engagement and professional performance and explore pedagogical learning models to transfer information systems to practical contexts, as well as highlighting the importance of cultural and ethical frameworks for computer applications and practices.

Conference papers will be published in international journals and indexed in major indexing services.

For further information, please visit:
http://www.ols-society.com/icis_2015/index.php

MAY
20 ▶ 21

London, UK

CONFERENCE

WIND FARM DEVELOPMENT: EUROPEAN OFFSHORE 2015

The Wind Farm Development: European Offshore 2015 conference will take place from 20 to 21 May in London, the United Kingdom.

The conference provides a platform for exploring the opportunities within the offshore wind industry and discussing the latest technological advancements to support recent industry growth. It will cover the latest success stories and case studies of established technology utilisation and ongoing progress in building an efficient supply chain to achieve an improved return on investment in the long term.

The two-day conference comprises a series of presentations, interactive Q&A sessions and panel discussions which will further highlight the approaches and strategies taken across the industry.

For further information, please visit:
<http://www.wplgroup.com/aci/conferences/eu-ewp5.asp>

EVENTS

For more forthcoming events:
<http://cordis.europa.eu/events>

MAY
24 ▶ 25

Madrid, SPAIN

CONFERENCE

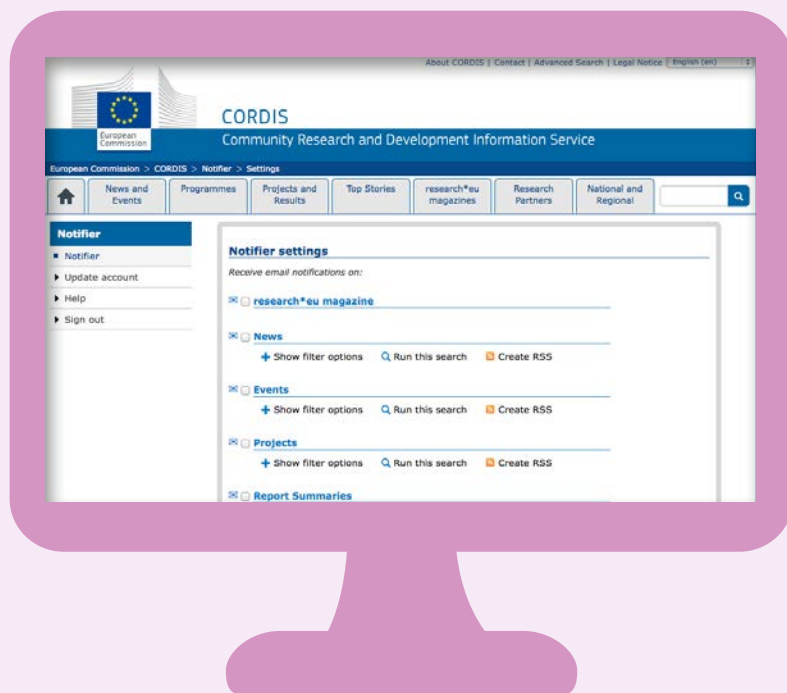
FOURTH INTERNATIONAL CONFERENCE ON TRAFFIC AND TRANSPORTATION ENGINEERING (ICTTE 2015)

The aim of the conference is to establish an effective platform for institutions and industries to share ideas and to present the works of scientists, engineers, educators and students. Keynote speakers include Prof. Eugene Jud from California Polytechnic State University, Prof. Monteiro Figueira from Lusofona University and Prof. Roberto Montemanni from the Dalle Molle Institute for Artificial Intelligence.

Registration fees range from approximately EUR 300 to approximately EUR 480.

For further information, please visit:
<http://www.ictte.org/index.html>

Explore more EU research results on CORDIS



CORDIS is the European Commission's primary public repository and portal for disseminating information on EU-funded research projects and their results in the broadest sense.

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