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SPECIAL FEATURE

SHAPING THE FUTURE OFFSHORE WIND

BIOLOGY AND MEDICINE

SCIENTISTS UNCOVER CLUES TO PREVENT DISEASE PANDEMICS

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ENVIRONMENT

FOREST FRAGMENTATION A DANGER TO VULNERABLE SPECIES

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EDITORIAL

by the editorial team

CAN OFFSHORE WIND SUSTAIN EUROPE'S FUTURE ENERGY NEEDS?

Offshore wind is considered by many as a cornerstone of an energy independent Europe. This alone would explain the EU's support for its development, along with the fact that the Old Continent currently leads in the offshore wind race: in 2015, Europe counted over 3 000 offshore wind turbines in 82 farms spanning 11 countries, for a total of 10.39 GW of wind energy capacity.

This figure is expected to grow to 23.5 GW by 2020, according to the European Wind Energy Association (EWEA). The association also tells us that what it calls the 'offshore wind scenario' — which would see cost reductions, a stable regulatory framework, improved access to finance, a fully integrated network, reduced red tape, fewer supply and logistic challenges, as well as coordinated R&D efforts — could save Europe some EUR 18 billion on fuel imports.

'There is still room for improvement to make offshore wind turbines more efficient, more cost-effective and more reliable.'

The last point, research and development, is crucial to reaching this objective: despite significant industry efforts and the funding of research under the sixth and seventh research framework programmes, there is still room for improvement to make offshore wind turbines more efficient, more cost-effective and more reliable.

The current trend — which sees turbines growing bigger and being installed further away from European shores — will require novel technologies, notably new turbines and components, novel offshore technology, further system integration and better resource management and spatial planning.

FP7 saw 25 projects funded in the field of offshore wind for a total of EUR 169 million, whereas H2020 is set to push the boundaries even further.

In this issue of the *research*eu results magazine*, we shed light on eight projects from these two framework programmes. From floating structures to easier and more cost-effective maintenance, superconducting technology, risk assessment solutions, grid development and innovative instalment techniques, all aspects of offshore wind innovation are covered.

As usual, this special feature is followed by eight other sections focusing respectively on biology and medicine, social sciences and humanities, energy and transport, environment, IT and telecommunications, industrial technologies, security and safety, and space. The magazine closes with a list of upcoming events hosted by or involving EU-funded research projects.

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

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SPECIAL FEATURE

SHAPING THE FUTURE OFFSHORE WIND

INTERVIEW

MULTI-MEGAWATT FLOATING SYSTEM SOON TO BE SET UP NEAR LE CROISIC, FRANCE

Floating wind turbines for offshore use are seen by many as embodying the future of the sector: they circumvent the problem of unsuitable seabeds and may even cost less than grounded alternatives. A consortium working under the FLOATGEN banner is looking for a share of the pie with the first-ever floating wind turbine to be set-up in the Atlantic close to the French coast.

FLOATGEN is looking to pioneer the expected burgeoning of offshore floating wind farms in European waters. To do so, it will set up a 2 MW turbine in the Atlantic Ocean, at the SEM-REV test site located 12 nautical miles from the city of Le Croisic. The seven-strong consortium hopes that this groundbreaking set-up — on a site which features an electrical substation connected to the national grid — will demonstrate the technical and economic feasibility of floating wind turbines and enable their development in windy and deep waters that are currently not commercially viable.

The demonstrator is using a cost-efficient, ring-shaped floating platform patented by Ideol. It boasts novel hydrodynamic properties that, according to its manufacturer, 'make its performance exceptional compared to other floating platforms.'

Paul de la Guérivière, CEO of Ideol and coordinator of the project, discusses the technology while the construction of its floating foundation is taking place.

★ Why is it important for France and Europe to invest in floating offshore wind turbine systems?

Paul de la Guérivière: At a time when offshore wind power is undergoing major developments, it is also confronted, in many countries, with a shortage of appropriate sites. As a result, floating wind power is slowly but surely establishing itself as a viable alternative to bottom-fixed wind power. Within this framework, Europe, and especially

France with its Mediterranean deep waters, has to be ready to not only compete in this burgeoning market, but actually seize the opportunity to become true market leaders.

★ What can you tell from the project's results so far?

Several tank tests have been performed and the engineering studies have now been completed. FLOATGEN is currently under construction: the floating foundation is taking shape, the wind turbine and more than 80 % of the mooring material have already been delivered to the Saint-Nazaire harbour.

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

The project will see an offshore wind turbine connected to the grid by the end of the year. This short timing — four years — has been very challenging for us, as we had to find a site where we could obtain the necessary permits and authorisation, to cope with the different changes in wind turbines, and to ensure that construction would be viable. On the technical side, the most challenging factor has been the interface with the different partners, for construction optimisation, for turbine supply. The strong interest of all partners in our technology and our aligned interests have been key when overcoming these difficulties.

★ What were your criteria for selecting the test site?

A combination of criteria has led to the choice of the SEM-REV test site off Le Croisic operated by Centrale Nantes: connection to the grid, water depth, distance from the shore... SEM-REV is indeed the world's first multiple MRE test site connected to the grid.

★ What have you learned so far with regards to the performance and cost of this technology?

We have no doubts about the performance of the floating system: our engineers have been working hard for 5 years and the tank test campaigns have already confirmed the outstanding performance of the overall system. Regarding costs, FLOATGEN gives us valuable experience and knowhow and allows us to define methods and processes for the construction, installation and operation of the floating system, and thus to identify cost reduction levers. We're also working on several R&D projects in order to continue optimising the mooring system which is a key part of the project.

★ What are your plans once the wind turbine is in place?

The demonstration time will last 2 years in SEM-REV waters. This period will allow us to assess the performance of our floater, to validate the operational and maintenance costs and to prepare for the industrialisation of this solution.

★ Any advice for other organisations tempted by offshore wind turbines?

To hurry up because the market is becoming structured and because our technology is ready to support commercial projects!

FLOATGEN

★ Coordinated by Ideol in France.
★ Funded under FP7-ENERGY.
★ http://cordis.europa.eu/project/rcn/107961
★ Project website: http://floatgen.eu/
★ http://bit.ly/2eMYEsc

© Paul de la Guérivière

PAUL DE LA GUÉRIVIÈRE

OFFSHORE WIND FARM MAINTENANCE COULD SOON BE A BREEZE

The EU-funded TOWERPOWER project is developing reliable new techniques to continuously monitor the structural condition of offshore wind turbines. Optimising maintenance and inspections is a key way to help the sector achieve cost efficiencies.

The project, which is entering its final year, is currently integrating cutting edge inspection techniques and preparing for final testing on offshore wind turbines. More accurate and cost effective monitoring will help wind turbine operators identify potential structural defects earlier, and enable better planning and scheduling of maintenance activities. Pioneering real-time wireless connectivity also means that the TOWERPOWER (Continuous monitoring of the structural condition of the tower and supporting structure of floating and static offshore wind turbines) system can be used to monitor offshore conditions on land, saving time and money.

Tapping offshore opportunities

The project builds on growing market demand for tailored offshore solutions. To date, offshore wind farm operators have often struggled to optimise their maintenance and inspection interventions, losing a competitive edge to other sources of energy able to achieve greater cost efficiencies. Addressing growing demand for bespoke offshore solutions is therefore a significant market opportunity for high tech businesses, and is why the project consortium — led by the French business cluster Capenergies — brought together five SMEs, three SME associations and three research centres to investigate and develop new solutions.

'What made this project interesting is that it is focused solely on monitoring rotating wind turbine structures offshore,' says project coordinator Dr Céline Auger from Capenergies. 'While a lot of monitoring solutions already exist for the onshore market, these are often not applicable to offshore installations.'

In addition, the last decade has seen risk-based inspection approaches applied in the oil and gas industry, and these have enabled operators to identify new strategies to inspect and control the deterioration in structures. The TOWERPOWER project also sought inspiration from some of these techniques in developing maintenance planning for offshore wind turbines.

Powerful practical solutions

'We decided to focus specifically on inspecting the transition piece of the wind turbine, the part that supports the nacelle (the section that houses all of the generating components in a wind turbine) and the tower itself,' explains Auger. 'This transition piece is made of a set of steel pieces some 40 mm thick, which are joined together by a 50 mm thick special concrete layer.'

Project partners next looked at ways of evaluating defects and tested two ultrasound-based techniques: acoustic emission and guided waves. These techniques enabled researchers to evaluate large surface areas and volumes of material, while at the same time detecting the precise location of any defect.

'We are talking about 40 to 50 sensors per tower, with the data then aggregated and transmitted from the nacelle to a shore supervisor,' says Auger. 'We have already carried out a number of experiments on models and simulations in order to fine tune the equipment. By the time the project is completed in 2017, we will have also taken into account environmental and weather conditions.'

A number of tests in water have been scheduled. These will help to monitor the impact of waves and the robustness of the processing unit, before the entire system is ready for testing on an offshore wind turbine. The finalised tool, says Auger, will be economically accessible and competitive, and will provide wind farm owners, operators and insurers with extremely valuable data to extend the life of turbines.

'In addition, we will produce a best practice and standardisation approach for test methods and implement a programme of information and training for inspection personnel,' she says. 'This will add great value to the wind sector as there are at present no standards for the inspection of these structural components.'


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TOWERPOWER

- Coordinated by Capenergies in France.
- Funded under FP7-SME.
- http://cordis.europa.eu/news/rcn/126506
- Project website: http://www.towerpower.eu/

10 MW WIND TURBINES ON A DIET THANKS TO SUPERCONDUCTING GENERATORS

The 10 MW threshold is not an easy one for the offshore wind industry to cross. Current turbines relying on geared or direct-drive permanent magnet generators are difficult to scale up any further, which explains why superconducting technologies are raising so much hope. The SUPRAPOWER project is bringing down the remaining barriers to their success.

The SUPRAPOWER (SUPerconducting, Reliable, lightweight, And more POWERful offshore wind turbine) promise is tantalising: a 'superconducting' (SC) direct-drive generator that is lightweight, robust and reliable enough to develop offshore wind to its full potential in Europe. The resulting wind turbines will be smaller and less expensive, operating and maintenance costs will be reduced, reliability and efficiency will be increased, and power conversion will be maximised.

'Several superconducting generator concepts have been developed or are under development, but some of the proposed concepts still face certain technical challenges that complicate their industrial feasibility for the very challenging offshore wind sector. These include, for example, the high cost of the superconducting material or the use of cryogenic fluids,' Iker Marino Bilbao, SUPRAPOWER coordinator, explains. 'Our MgB2 superconducting generator overcomes these challenges.'

A challenging development process

Developing the MgB2 generator is far from a walk in the park. 'Due to the novelty of this technology, there was not much existing experience in key aspects such as rotating MgB2 coils,' Bilbao says. 'We had to proceed in phases: first, two small test coils to validate the design and manufacturing process; then, a full size double pancake coil for testing; and finally full scale field coils.' The cryostat required a similar approach, with first a dummy one and, based on experimental results, final cryostats which are currently under construction.

'Another challenge is that any modification in one component affects the others, as the different parts (coils, poles, cryostats, etc.) will be assembled together in the scale machine. Technical coordination is key, just like finding qualified manufacturers for some of the components which has proved to be more challenging than we first thought.'

Reduced weight

The project, which is scheduled for completion in May 2017, is well on track to meet its ambitious objectives. The conceptual design of the 'superconducting generator' (SCG) has been completed, and the team has been able to compare its performance in a wind turbine with that of a 'Permanent magnet generator' (PMG).

They observed a 26% weight reduction in the wind turbine's active parts, an overall reduction of 16% when counting the support structure, and an 11% reduction in the tower weight. This will notably enable a considerable drop in shipping and deployment costs. 'One of the most challenging marine operations will be the installation of blades, which are exactly the same in both cases,' Bilbao points.

A rotary magnetic scale machine has also been designed to validate the 10 MW generator concept. It consists of an external rotor with two superconducting field coils currently in their final manufacturing process. The two coils are made of a stack of nine racetrack MgB2 double pancake coils connected in series between two thick copper plates. Both field coils are wrapped into a modular cryostat around an iron pole, and heat is extracted by conduction through a thermal collector that links both coils. The cryostats are still under construction but dummy versions have already been constructed and tested. The rotary joint, on the other hand, has already been designed, manufactured and fully tested.


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'Currently we are in the process of manufacturing all elements of the scale machine and we expect to complete its experimental validation in May 2017,' Bilbao says.

Appealing to the market

Whilst the project team still needs to further analyse the market potential of their technology, they are positive that deployment will be slightly easier than with conventional turbines. Transportation and installation can be done with present-day equipment and with no major differences with wind turbines in the same power range.

Superconducting elements are highly reliable and their maintenance is reduced to vacuum pumps and cryocoolers. However, even though these are well known industrial components, the fact that they have never been used in such an application means that the first full-scale prototypes and commercial units will initially require special care and monitoring.

'If we succeed in proving the feasibility and advantages of this novel generator concept, the next major step would be to engage a wind turbine or wind generator manufacture for further developing these technologies and proving them at MW scale,' Bilbao concludes.

SUPRAPOWER

- ★ Coordinated by Tecnalia in Spain.
- ★ Funded under FP7-ENERGY.
- ★ http://cordis.europa.eu/project/rcn/106228
- ★ Project website: http://www.suprapower-fp7.eu/

A RISK ASSESSMENT APPROACH TO UNLEASHING OFFSHORE ENERGY POTENTIAL

Environmental Impact Assessments — which generally tend to be completed before offshore renewable energy plants can be built — could be delivered much more cost-effectively through applying a risk-based approach, say EU-funded researchers.

Whilst the nature, scale and impact of offshore renewable energy developments can vary significantly, all require consent based on whether the receiving environment is likely to be significantly impacted. This type of determination is based on investigations and surveys of specific environmental parameters to that ensure there is compliance with over-arching environmental legislation. The cost and time taken to conduct these impact assessments — in addition to the uncertainty over the potential environmental effects of novel technologies — remains a key barrier to the development of the sector. This means that the full job-creating and energy-producing potential of European wind, wave and tidal power has not been fully unleashed.

Risk-based approach benefits

After identifying this issue as a major constraint, the EU-funded RICORE (Risk-based Consenting for Offshore Renewables) project got to work to develop practical solutions designed to help get new offshore energy projects off the ground. 'What we did was develop a novel risk-based approach to consenting that aims to reduce the time and cost involved,' explains project coordinator Professor David Gray from Robert Gordon University in the UK. 'We found that by using risk profiles, scientists and regulators can reduce the amount of survey data needed for known technology in areas of low environmental sensitivity.'

A risk-based approach enables regulators and industry to prioritise their activities, based on previous data. In order to put this together, the project began by profiling Member State consenting processes, exploring how risk is currently addressed in consenting and examining how these fit with EU legal requirements.

'What we found was that an absence of an "Offshore renewable energy" (ORE)-specific consenting process, the lack of clear and focused guidance and multiple competent authorities can all act as key barriers to project consenting,' says Gray. 'What we'd like to see is guidance to explain risk-based approaches to regulators and developers as well as other marine users.'

To this end, the project sought to build upon existing guidance known as Survey, Deploy and Monitor (SDM) policy to include all relevant technologies in the ORE sector, and to ensure that SDM can be applied within a risk profiling approach. A number of recommendations were put forward, including establishing common criteria for the evaluation of environmental sensitivity at a specific location and updating and reviewing the expected environmental impacts of different technologies.

Implementing the new approach

In order to put a risk-based approach into practice, the project developed guidance for pre-consent surveys in the Member States that takes into account lessons from previous surveys. Information on pre-consent monitoring practices was compiled on a variety of environmental aspects, including potential impacts on seabirds, marine mammals, fish and shellfish. 'A power analysis of existing information can help to identify

specific data required by regulators,' says Gray. The information gathered is available through the project website.

Finally, the project also looked at best practice for post consent and post deployment monitoring strategies. 'Currently Member States do not have cohesive strategies for undertaking operational monitoring,' says Gray. 'There is a need for a question-led approach, and a need for decision makers to engage with the issues more so as to ensure the monitoring conducted is answering the correct questions. Regulators need to apply risk-based approaches here.'

The impact of the RICORE project, which was completed in June 2016, is likely to be felt by industry over the long term. The guidelines and policy recommendations put in place will help to nurture a risk-based approach to ORE deployment by both regulators and industry, ensuring the cost-efficient delivery of pre-consent surveys that fully meet environmental requirements. In this way, a significant non-technical barrier to the development of this sector — vital to Europe's green economy — will be removed.

RICORE

- Coordinated by Robert Gordon University in the United Kingdom.
- Funded under H2020-LCE.
- http://cordis.europa.eu/news/rcn/126470
- Project website: http://ricore-project.eu/

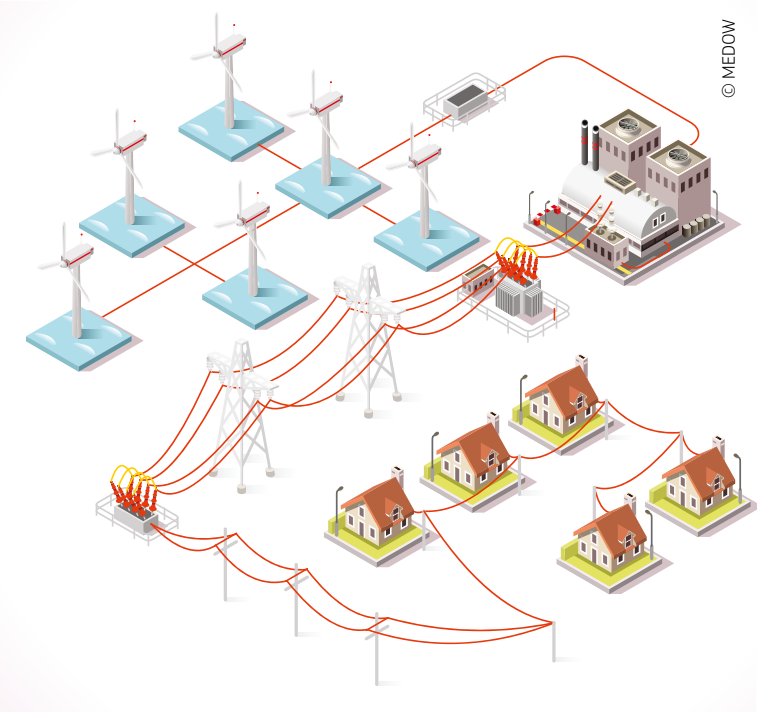
INTERVIEW

ENABLING THE OFFSHORE WIND SUPERGRID

In 2010, world leading companies in offshore wind came together to form 'The Friends of the Supergrid' — an association that advocates for an efficient, interconnected and resilient electricity grid to complement existing national transmission infrastructure. The MEDOW project is playing its part by advancing research on multi-terminal DC grids, which are considered as the key technology to connect offshore wind farms to this supergrid.

MEDOW (Multi-terminal DC grid for offshore wind) is a Marie-Curie action with two purposes: training a new pool of researchers and cross-fertilising expertise in DC grids; and studying operational issues related to their adoption in offshore wind farms. These include questions related to DC power flow, DC relaying protection, steady state operation, dynamic stability, fault-ride through capability, and impacts of DC grids on the operation of AC grids and power markets.

A few months before the end of the project in March 2017, MEDOW coordinator Jun Liang of Cardiff University discusses early results and the project's expected impact on the realisation of the supergrid.



© MEDOW

How is a multi-terminal DC Grid a key enabler for the European Supergrid?

Jun Liang: 'High-voltage direct current' (HVDC) technology has already proven to be a highly efficient solution for transmitting large amounts of electric power over long distances and in applications such as carrying offshore wind power to shore, cross country interconnectors and AC grid reinforcements.

As the number of these point-to-point connections increases, it could be beneficial to connect them directly rather than through AC corridors, forming a 'Multi terminal DC' (MTDC) grid. This is raising interest in the pan European Supergrid, where more 'Renewable energy sources' (RES) can be integrated.

Furthermore, the number of HVDC connections is not so small in Europe, with a foreseen growth of 30+ HVDC connections within the next five years, starting with undersea connections, but later on even with longer overhead lines. The only possible solution to meeting energy needs in the long term lies in MTDC networks connecting the whole continent and the RES in the North Sea via offshore grids — which is commonly called the European Supergrid.

The key benefit of HVDC grids is a chance to obtain very reliable, mostly clean energy almost everywhere in Europe. Moreover, the power lines can be either 'invisible' (cables), or rather compact compared to standard AC lines.

What can you tell of the project's most notable results so far?

The MEDOW project's most important contribution is how it managed to bring together academia and industries to work on MTDC grid development, towards a sustainable Europe. In addition, this collaborative project provides the platform for training and developing early career researchers in order to fill the shortage of skilled and experienced work forces in the field of power systems.

The MEDOW project's contribution to the technical community can be summarised with one book on HVDC grids, one patent (pending acceptance), 60+ technical research papers in top academic journals and notable international


© Jun Liang

JUN LIANG

conferences along with engagement with local communities. Most of the research output has received high appreciation from industry partners. They are very keen to take up these outcomes and use them in practical applications.

★ What are your plans for building on or disseminating the project's results after its end, if any?

Europe's energy needs are changing along with economic and policy developments. To support this trend, MEDOW sought to promote its findings and results so as to make the supergrid a reality. This has been achieved through engagement with industrial partners and organisations like Friends of the Supergrid — a Brussels-based association of international companies that promotes the policy agenda for a European supergrid.

The success of the project has motivated the consortium to consider applying for future funding to continue the project under MEDOW 2. Furthermore, we are also involved in the Vision2020 Network, a pan-European research network for SMEs and universities, where we head the Energy cluster. This should help us engage with an even greater number of academics, companies and institutions as they seek to address the big issues around Europe's energy management.

★ One of your main objectives was to foster greater ties between industry and academia. How did that work out?

The participation of industrial partners is crucial for projects like MEDOW, which aims at introducing real world applications. Their insights on recent trends, developments and practical implications are vital for proper research directions. In this regard, it has been very rewarding to work together with top-notch cross-border industrial and technical partners on this project. It has really allowed us to push the technology barriers and to bridge the gap between industry and academia through the validation of our ideas.

In addition to this, the secondments provided for each of the MEDOW researchers with industry partners allowed them to reach out to a wider community outside academia. This opportunity gave them a chance to interact, network, and collaborate with the respective technical partners, and get an insight into the culture and environment of geographically dispersed institutions.

★ Overall, do you expect the project results to impact the development of offshore DC grids?

Yes, I do believe the outcomes and findings of the MEDOW project can be used as a roadmap for the development of future offshore DC grids. Through the MEDOW project we were able to tackle most of the uncertainties standing in the way of technological progress and to nurture a strong workforce capable of dealing with the new age mixed AC/DC power system. The outputs of the MEDOW project can be effectively used to reduce the timeframe for the realisation of a pan European grid.

MEDOW

★ Coordinated by Cardiff University in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/project/rcn/106752
★ Project website: http://sites.cardiff.ac.uk/medow

PUTTING WIND IN THE SAILS OF EUROPE'S OFFSHORE ENERGY SECTOR

Through a unique training programme that brought industry and academia together, the EU-funded MARE–WINT project has helped to fill a significant skills gap in the burgeoning offshore wind energy sector.

The end result of the MARE–WINT project has been impressive. PhD degree specialists covering fields such as aerodynamics, structural mechanics and operation and maintenance have come through this unique programme with the knowledge and skills to develop Europe's offshore wind sector and enable it to realise its full potential.

'Wind generation has been identified by policy makers and industry alike as a clean and secure means of reducing dependency on polluting fossil fuels and limiting over reliance on energy imports,' says MARE–WINT project coordinator Professor Wiesław Ostachowicz from the Polish Academy of Sciences in Gdańsk. 'It also requires very little water to produce electricity – unlike nuclear and fossil fuels – and this is hugely important given the growing threat posed by water scarcity.'

But while the environmental case for wind energy has been effectively made, the perceived cost of producing electricity from wind turbines has somewhat constrained market growth. 'This is why the offshore energy industry is focused

on increasing the reliability of offshore wind turbines and reducing the need for maintenance,' explains Ostachowicz. 'Finding new ways of achieving these aims is crucial if the offshore wind turbine sector is to accelerate and grow.'

Training tomorrow's offshore experts

The EU-funded MARE–WINT project was launched following recognition that a crucial skills gap exists. Knowledge from disciplines ranging from mechanical engineering and material science to metrology, fluid mechanics and computer simulation are desperately needed in order to design, build and operate the next generation of reliable and efficient turbines. In order to achieve this, MARE–WINT brought together six universities, seven research institutes and 10 private sector enterprises to form a training network and provide doctoral programmes tailored to the future needs of the offshore wind sector.

'In practical terms, we've helped to provide the missing connection between employers — wind turbine industry companies — and their potential workforce by training 14 future offshore wind turbine researchers,' says Ostachowicz. 'This will also help to accelerate research in areas targeted by European policy makers — such as renewable energy — in order to prevent global warming and climate change.'

The participation of 13 private sector partners active in off-shore developments was essential for the success of the project. Industrial partners were involved in hosting, training and defining the training needs of the researchers. The strong involvement of industry will give PhD students the widest possible employment prospects.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Sustainable energy benefits

While the MARE–WINT project achieved its key objective of decreasing skill gaps in the sector, it has also provided advances in the design and operation of turbine blades, drive-trains and support structures that will be of benefit in the long term. A number of industrial partners were able to fine tune existing tools and methods that are used on a daily basis, thereby improving performance immediately.

Finally, the project's outcomes have been presented in a published book that will be used in universities as training material for courses on wind energy technologies. The future for wind energy remains bright; the sector contributed EUR 32 billion to the EU economy in 2010 and as of 2012, 250 000 people in Europe had a job linked to wind energy. By 2020, the sector is projected to have generated 520 000 jobs.

MARE–WINT

- ★ Coordinated by IMP PAN in Poland.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/news/rcn/126567

INTERVIEW

A SUBMERSIBLE BOAT FOR OFFSHORE WIND STRUCTURE MAINTENANCE

In 2009, a UK SME going by the name of Scubacraft introduced the world to their convertible speedboat/submarine. Seven years later, the project has been granted support under the SME Instrument, and the company is now contemplating new markets including offshore wind farm maintenance.

Scubacraft has tremendous potential: from leisure to underwater operations, the company can count on the interest of pretty much all sectors interested in James Bond-esque, flexible and powerful marine or submarine transport solutions.

The submersible boat is able to carry up to six people and a large amount of equipment. It is available in six combinations (three or six people and standard, all-electric and carbon-fibre made versions), can ride the waves at up to 80 km/h, and can go as deep as 50 metres in its most advanced version. Built-in equipment includes an integrated GPS and dive computer, an on-board air supply with a reserve and integrated storage and equipment racks. Additionally, customers can request other features such as an underwater filming platform, an imaging sonar, underwater communications, a custom trailer, lighting and equipment racks, etc.

Thanks to all these features, the company is confident that Scubacraft will become 'the state of the art technology for use in underwater industrial applications for the energy industry sector, specifically offshore inspections for wind turbines.' But they also contemplate other possibilities such as marine conservation and search and rescue operations: as these sectors typically resort to inspection divers to carry equipment to the inspection site and then perform the inspection, the use of a submersible boat can accelerate operations and maximise efficiency.


© SCUBACRAFT

With the EU budget granted in July 2016 under the SCUBACRAFT (Submersible vessel used for multi-purpose sub-aqua applications to enhance marine life, environment conservation and structural integrity of offshore installations) project, the company is investigating these new uses and their market potential.

James Brown of Scubacraft discusses the submersible boat, its potential and early results from the EU-funded feasibility study ahead of the end of phase 1 in December 2016.

What makes Scubacraft a must-have for offshore wind farm inspection?

James Brown: Currently underwater inspections involve human divers, carrying inspection equipment below the sea surface. Divers can realistically spend up to 10 minutes at 40 m below sea level before they need to begin their ascension to the surface due to the limited amount of available oxygen.

"We have been delighted by the letters of support that we have received when validating Scubacraft for use in offshore windfarm inspection."

This means that any structural defect in the structure being repaired could potentially be missed due to the insufficient time spent performing the inspection, and hence that the situation is more likely to escalate to an advanced state prior to repairs.

Can you tell us more about your technology and the way it works?

What makes Scubacraft unique is our patented technology which enables the vessel to submerge below the sea surface and then use hydrodynamic control to operate seamlessly below the waterline.

Once the underwater activity has been performed, the vessel can re-emerge above sea level, travel at high-speed on the surface and return to shore. The unique twin-hull design is a result of world class development: Scubacraft is designed like no other watercraft to offer unrivalled flexibility and mission efficiency. The streamlined shape and hydrodynamic features are essential to operate both above and below water.

What has been the market reception so far?

The market has reacted extremely positively to Scubacraft and we have been delighted by the letters of support that we have received when validating Scubacraft for use in offshore windfarm inspection.

Why did you decide to apply for EU funding?

Horizon 2020 which is the biggest EU Research and Innovation programme and as such is the perfect platform to take Scubacraft from prototype to markets where it will be resolving real-world challenges. Having seen the brightest minds in the UK and Europe combining forces to work on highly influential projects, we hope that we can adopt a similar approach and bring a pool of talent together for the Scubacraft programme.

What have you learned from the feasibility study so far?

We have learnt tremendous amounts. The feasibility study has allowed us to engage experts such as RMS Submarine. They have been able to provide a wealth of information on the likes of safety, marine sector opportunities, route to market, vehicle payload, etc.

Will you be applying for phase 2 funding?

Yes, the current objective for Scubacraft is to apply for phase 2 once we have submitted the Phase 1 feasibility study.

SCUBACRAFT

- Coordinated by Scubacraft in the United Kingdom.
- Funded under H2020-SMEINST.
- http://cordis.europa.eu/project/rcn/204274
- Project website: http://www.scubacraft.com/


© James Brown

JAMES BROWN

INTRODUCING THE SELF-INSTALLING OFFSHORE WIND TURBINE

Researchers have developed an offshore wind turbine system that can be completely pre-assembled and pre-commissioned in controlled harbour conditions.

Although wind power is highly regarded as an important source of sustainable energy, the costs of installing the necessary turbines have always been an obstacle to its widespread adoption. This is particularly true for offshore windfarms, which require large, high-tech wind turbines to be constructed — and maintained — in the oceans themselves.

Thanks to an innovative offshore wind turbine construction process developed by the ELISA project, this traditional barrier to the use of wind energy has finally been overcome. This innovation, the ELISA (Self-bouyant precast concrete foundation for the craneless installation of complete offshore wind turbines: full scale offshore protype) technology 5 MW fully operational prototype, is located in the Canary Islands and is the first bottom-fixed offshore wind turbine completely installed without the need for costly and scarce heavy-lift vessels.

'The ELISA technology is a pioneer in the development of completely self-installing offshore turbines', says project engineer José Serna. 'The entire system is completely pre-assembled and pre-commissioned in controlled harbour conditions, enhancing the possibilities for industrialisation and minimising risks related to offshore assembly work.'

Telescoping technology

The ELISA 5 MW prototype uses a gravity-based foundation, which essentially serves as a floating platform from which an automatically telescoping tower complete with wind turbine is anchored. Each unit — platform, tower and turbine — is completely assembled onshore. It is then towed to its open-water site using conventional tugboats, where the platform is secured and the tower raised.

'It's important to note that currently there are only three or four heavy-lift vessels in Europe capable of installing an 8 MW turbine in waters deeper than 40 metres — and Europe leads the way in comparison to other developed markets', says Serna. 'In other words, this system will also be a key European export to such markets as the US and Japan.'

What's particularly unique about the system is that the telescopic configuration of the tower was designed to bring down the unit's centre of gravity, meaning the platform serves as a self-stable floating barge from which the crew can preassemble the entire system inshore. Being able to build the structure inshore, as opposed to the open and often treacherous waters of the ocean, brings a huge reduction in the human risks that so often accompany the assembly of open water wind turbines.

'This vessel-free installation capacity is not only a source of large cost reductions, but also a way to support the clear trend towards larger offshore wind turbines, a key step towards improving a wind farm's cost of energy', explains Serna.

Once tugged into its out-at-sea position, the platform is ballasted to rest on the seabed. Then when secure, the tower is lifted to its final position via cables and conventional heavy-lift strand jacks. These jacks start by lifting one level of the tower, and then are reused to lift the next level, and the next, and so on until fully built. Furthermore, the jacks are supported by the one below, which also guides the hoisted tube as it rises in a self-installing procedure where the tower itself is the only supporting structure required. And all of this is done from a single access platform.

Many advantages

'ELISA will allow for drastic cost reductions in the substructure supply and in the installation costs of offshore wind energy, which is set to play a strategic role in Europe's evolution towards a low-carbon and locally sourced energy mix', says Serna. 'As a matter of fact, the cost per MW of the prototype being developed is already below current market prices, despite all the investment required in auxiliary infrastructure and means whose complete costs have been dedicated to a single unit.'

According to Serna, the ELISA system can significantly reduce costs by as much as 30-40 % compared to traditional solutions based on jackets or XL Monopiles. It also saves users on maintenance and upkeep — significant costs for turbines facing the brutal elements of the open sea on a daily basis.

Thanks to ELISA's robust, durable and fatigue-tolerant and maintenance-free concrete substructure, researchers claim the system will improve the integrity of the structure and reduce operational costs. As an added bonus, the system is noiseless and more environmentally friendly than steel alternatives with regards to its impact on sea life and carbon footprint.

ELISA

★ Coordinated by Esteyco in Spain.
★ Funded under H2020-SMEINST.
★ http://cordis.europa.eu/news/rcn/126526


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BIOLOGY AND MEDICINE

SCIENTISTS UNCOVER CLUES TO PREVENT DISEASE PANDEMICS

EU-funded researchers have examined new ways of rapidly detecting infectious pathogens — such as rabies and influenza — in order to prevent pandemics.

Zoonoses — the natural transmission of viral diseases from animals to humans — represent a persistent global threat to our health. Scientists are striving to better understand how new human pathogens emerge in order to put in place strategies that effectively prevent widespread outbreaks, such as the tragic 2014 Ebola outbreak in West Africa and the current Zika virus outbreak in South America.

The EU-funded PREDEMICS (Preparedness, Prediction and Prevention of Emerging Zoonotic Viruses with Pandemic Potential using Multidisciplinary Approaches) project has been at the forefront of this endeavour. Launched in November 2011, this five-year project has investigated ways of detecting a range of infectious pathogens — such as rabies, the human influenza virus and Ebola — quickly and simultaneously. This was accomplished through diligent research on identifying the key viral mechanisms that are involved in evading the host's immunity.

The success of this work will contribute towards the design of effective disease prevention, control and treatment strategies as well as pandemic preparedness and response. Significant progress was made for example in better understanding influenza viruses, which can cause seasonal epidemics and occasional pandemics.

The flu virus spreads between people by different routes, including through the air in droplets and aerosols and through direct contact. However, the contribution of these different transmission routes in human influenza outbreaks is difficult to quantify and has to date been poorly understood.

In order to address this, the project team studied transmission routes in animals inoculated with mixtures of antiviral drug-sensitive and resistant viruses. By housing ferrets under different conditions, the PREDEMICS team was able to mimic various routes of transmission, such as through the air and through direct contact. Ferrets were chosen because they show a similar distribution of 'sialic acid' (SA) receptors to humans, which enable incoming viruses to enter target cells. Ferrets also display clinical signs after infection reminiscent of influenza-like symptoms in humans.

The scientists found that, for animals with a mixed infection of viruses that were resistant and sensitive to the antiviral drug oseltamivir, resistance was propagated through contact transmission but not by air. This implies that transmission events with a looser bottleneck can propagate minority variants and may be an important route for influenza evolution.

Project partners also found that viral isolates from patients with severe H1N1 infection (originally known as swine flu) displayed higher genetic heterogeneity compared to patients with mild forms of the disease. This underscores the importance of genetic variation in virus adaptation. And studies on infected bat colonies and red fox populations also provided novel insights.

For instance, the prevalence of lyssaviruses (which include rabies) depended on bat colony size and the number of species. Such findings will contribute towards better infection control methods in wildlife. Two major studies on the Zika virus — another mosquito-borne disease — funded within the PREDEMICS consortium have recently been published in 'The Lancet'.

All data amassed through the PREDEMICS project has been collected and compiled in a freely accessible data-sharing platform, which has enabled further analysis since October 2016. Furthermore, training in leading European universities, as well as exchanges of approaches and data sharing with national and international health organisations, has been carried out in order to strengthen Europe's position in this global challenge.

PREDEMICS

★ Coordinated by the Pasteur Institute in France.
★ Funded under FP7-HEALTH.
★ http://cordis.europa.eu/news/rcn/125960
★ Project website: http://predemics.biomedtrain.eu

OPTOACOUSTIC MESOSCOPY READY TO REVOLUTIONISE MEDICINE

The skin is a major organ which can be affected by a wide spectrum of diseases. However, the modern portfolio of skin imaging techniques lacks either penetration depth (optical techniques) or sufficient contrast (ultrasound). To overcome these obstacles, the HIFI project team have developed clinical broadband optoacoustic mesoscopy, which is the only technique that can image the entire skin depth at high resolution and with high contrast. This technique has the potential to profoundly change what we know about and how we treat many major diseases.

Skin diseases heavily impact society at both socio-economic and healthcare level. Current state-of-the-art optical imaging techniques — such as dermoscopy and confocal microscopy — provide only a partial view of the skin. They are also strongly affected by light scattering, which limits the penetration depth to a superficial few hundred micrometres. These optical techniques cannot visualise the full skin depth, which is around 1.5 mm.

Since the skin vascular structure reflects symptoms of a wide variety of diseases from multiple fields of medicine, it would be of great interest and importance to have an imaging method that can visualise the skin vasculature. While 'Optical coherence tomography' (OCT) can image slightly deeper than a few hundred micrometres by using coherence gating, the nature of the contrast mechanism does not resolve issues surrounding biologically relevant compounds such as haemoglobin. Similarly, ultrasound can penetrate deep into the tissue, but relies on the administration of external agents to resolve haemoglobin issues at high resolution.

"The system has a tremendous potential to impact the diagnosis of skin diseases and treatment strategies over the long term."

With financial support from the EU, the HIFI (Hybrid fluorescence optoacoustic imaging) team assessed the capabilities of a novel optoacoustic mesoscopy system for skin imaging. The outstanding feature of this particular technology is the use of optoacoustic detectors capable of detecting broadband signals. The frequency content of these signals ranges from a few dozen MHz to almost 180 MHz. Such broadband capabilities enable the imaging of objects at different scales, ranging from ~ 5 µm to ~ 100 µm deep in tissue (~4 mm). It is important to note that the system was miniaturised to enable a more user-friendly, handheld operation.

Using tissue-like materials, the researchers confirmed the system's ability to depict small structures identified as the smallest skin capillaries as well as the larger vessels of the deep dermis. In addition, reconstructed images from subsequent *in vivo* experiments also revealed the whole skin vascular structure plus additional epidermal elements, such as the *stratum germinativum* and the *stratum corneum*. The vasculature was derived from the strong optoacoustic signals generated by haemoglobin. This was the first *in vivo* demonstration of the feasibility of using skin vascular structures for diagnostic purposes.

Pilot studies on skin conditions such as psoriasis, eczema, vasculitis and angioma suggested that the system has a tremendous potential to impact the diagnosis of skin diseases and treatment strategies over the long term. Since the skin vascular system indicates symptoms of not only skin-associated diseases but also other malignancies (for example diabetes or hypertension), the impact of optoacoustic mesoscopy is expected to expand well beyond the dermatology field.

As a necessary step towards clinical translation of the technology, the HIFI team has already started to move from the proof of concept prototype to building a stable system, exploring the limits of its imaging abilities, identifying specific clinical needs beyond skin-related diseases and quantifying the true impact of the system in the respective clinical setting.

HIFI

- Coordinated by Helmholtz Zentrum München in Germany.
- Funded under FP7-PEOPLE.
- http://cordis.europa.eu/result/rcn/188380

MIGRAINE ATTACKS TACKLED HEAD-ON

Millions of European people suffer from migraine, a devastating but poorly understood brain disease. EU funding enabled researchers to study the underlying brain physiology involved in migraine attacks.

Migraine aura, which precedes the headache phase in about one out of three patients, has a range of neurological symptoms and can last for anywhere between five minutes and one hour. The underlying neurological mechanisms of the spontaneous start of the aura phase, and its relation with subsequent headaches, are yet to be elucidated as the diverse range of brain systems involved calls for a multidisciplinary approach.

Researchers with expertise in functional neurobiology conducted several multidisciplinary experiments under the aegis of the UNDERNEATH MIGRAINE (Underneath the attack: cortical network function in migraine) project. To study factors contributing to migraine susceptibility, they used migraine mouse models with human pathogenic mutations.

Researchers first set up *in vivo* electrophysiology systems to record brain activity in freely behaving mice. Through this, they could monitor neuronal activity as well as behaviour, with an emphasis on the phenomenon 'Cortical spreading depression' (CSD). CSD has been associated with migraine aura, a condition where blurry vision and increased sensitivity to light are just two of the many common symptoms.

Project members made several exciting discoveries. The freely behaving migraine mice occasionally displayed CSD events in the absence of chemical or electrical triggers. Enhanced cortical excitability was seen in areas beyond the visual cortex, the suspected site of origin for migraine auras. They validated the utility of visual evoked potentials to detect cortical excitability. A first, research outcomes provided evidence of predictive neuronal activity changes prior to CSD.

The stress hormone corticosterone enhanced CSD susceptibility in migraine mice, but not wild-type mice. Using behavioural allodynia measurements, pre-treatment with the migraine drug sumatriptan normalised migraine mice that had previously displayed enhanced sensitisation.

Using optogenetics, researchers successfully and non-invasively induced CSD by shining blue light on the skull of anesthetised and freely behaving transgenic mice. As a useful tool for studying metabolic changes, the team also developed an ion-sensitive electrode prototype for *in vivo* brain recordings of pH and K+ during CSD in living mice.

Experiments revealed CSD-related migraine-specific neurobiological changes by monitoring metabolic, inflammatory and neuroplasticity markers in migraine mice. Study outcomes led to further collaborations with epilepsy researchers and the awarding of a US CURE SUDEP fellowship.

Although the project has ended, the research team is currently studying neuronal excitation-inhibition balance in specific brain regions to dissect migraine network mechanisms using optogenetic techniques. Results are expected to provide novel insight into the co-morbidity of migraine and epilepsy. Outcomes should help improve therapeutic strategies for migraine.

UNDERNEATH MIGRAINE

★ Coordinated by Leiden University Medical Centre in the Netherlands.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/188383

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SMART DEVICES AND APPLICATIONS FOR HEALTHY AGEING

The UCD Institute of Food and Health tells us that cognitive decline, malnutrition and sedentariness are the main causes of morbidity and premature mortality in older people. However, cognitive games, sensor networks, location systems and other smart devices developed under the DOREMI project could help counter these evils.

Through PCs, TVs and tablets, DOREMI (Decrease of cOgnitive decline, malnutRition and sedentariness by elderly empowerment in lifestyle Management and social Inclusion) aims at no less than prolonging older people's functional and cognitive capacity. It focuses on prevention by conducting food intake measurements and personalised metabolic control, providing exergames to stimulate social interaction, and defining cognitive training programmes within the framework of a pilot study. All in all, DOREMI resorts to multidisciplinary research in the fields of serious games, social networking, wireless sensor network, activity recognition and contextualisation, as well as behavioural pattern analysis.

'By recording and monitoring information about the use of the adopted lifestyle protocols, it is possible to track the user's performance over long periods, providing a potential alert for signs of malnutrition or physical and cognitive deterioration,' says Prof Oberdan Parodi, coordinator of the project. 'The close collaboration between healthcare representatives and experienced technological partners enabled us to release a set of prototypes to be validated in the pilot study.'

Networked apps and devices

The DOREMI system involves four core technologies and three apps. The technologies include the 'Smart Carpet' — a Wii-based balance board for daily weight assessment, an Android tablet containing all apps, a bracelet collecting patient metrics and sending it to a centralised home-based station, and about 10 environmental sensors installed in patients' home to check their habits and measure their level of socialisation.

Each app focuses on a specific ageing-related issue: fitness, cognition via a series of games, and diet. 'Thanks to a visual approach the user can fill in a personal food diary, selecting food types and portions by means of images. Medical doctors will remotely check the diary and, if necessary, modify the participant's diet to promote healthy nutrition according to the general guidelines promoted by DOREMI,' Prof Parodi explains.

All collected data, be it from the serious games or other apps and devices, is integrated and displayed on the physician's dashboards, which allow for remote inspection and control of the devices as well as well as providing information about the patient's status. This all implies the set-up of a dedicated server in the patient's home.

'Each single installation has its own specific plan, and devices are linked to their actual position in the HOMER database,' Prof Parodi says. 'This installation information, which is anonymous for privacy reasons, is also very important for the interpretation of the acquired data: Think of what would happen if the caloric consumption of an individual is mixed with the food intake of another by mistake!'

Successful trials

The DOREMI system has been tested extensively for two and a half years. 32 older people aged between 65 and 80 years old were involved in three-month trials taking place in the UK and Italy.

'Subjects were characterised at baseline in terms of physical activity (SPPB, PASE test, daily steps/meters, 6MWT), heamodynamic and biochemical parameters (blood pressure, HR, lipid profile, glycaemia, etc.), dietary habits (caloric intake) and balance assessment (BERG scale). They were stimulated to perform an indoor physical activity protocol (exergame on a tablet); monitored by the DOREMI bracelet; invited to fill in a diet e-diary to receive nutritional advice provided by an expert; and tested for balance (DOREMI smart balance board). At the end of trial, users underwent the same test battery of baseline,' Prof Parodi points out.

The UK trials ended in April 2016, and 15 people over the age of 65 were enrolled to participate to the validation phase in three different villages. The first reports from the UK trials have been received, whilst the data from Italy is undergoing deeper evaluation.

Patients evaluated the DOREMI solutions as being excellent: 'Residents at ExtraCare and Accord in the UK have formed friendships in a group of residents who otherwise might not have got the chance, whilst encouraging a healthy lifestyle and active mind,' Prof Parodi says.

In both test sites, the DOREMI population saw an overall increase in physical activity, a significant improvement in haemodynamic (decrease in blood pressure at a six-minute walking test) and in tests scores for increased short physical performance. Changes in dietary habits have also produced remarkable effects on blood markers and somatometric parameters.

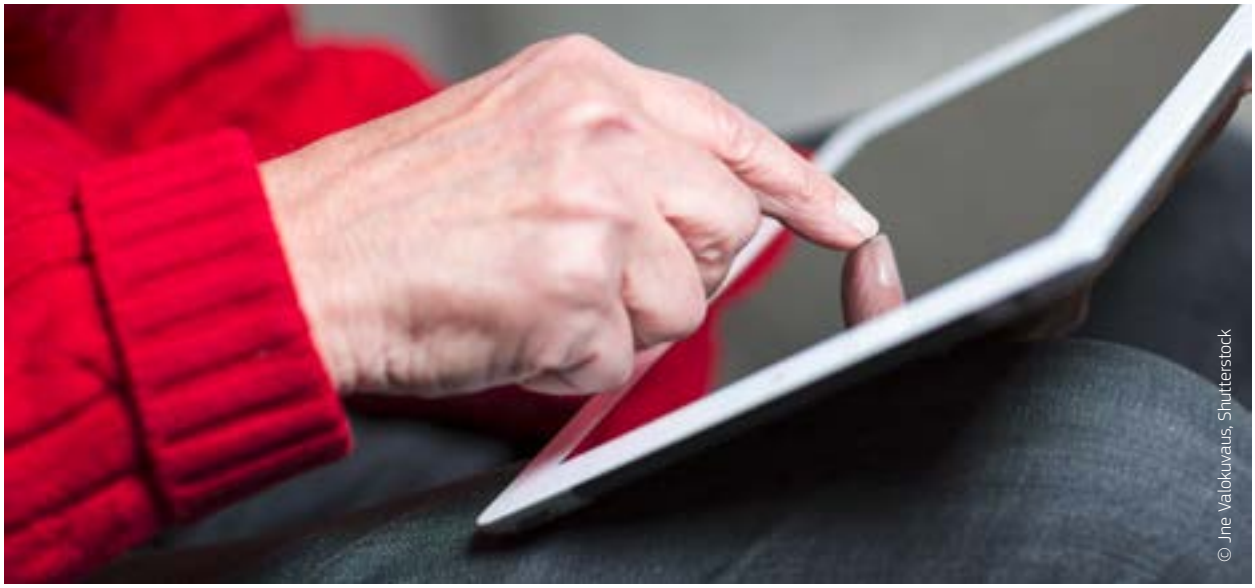
Towards use in real-life situations

Whilst the consortium doesn't have commercialisation plans as of yet, there are plans for applying a subset of the DOREMI system to a real-life situation in Pisa, Italy. The Pisa Municipality started a project where a subset of the DOREMI system will be used to monitor the behaviour of elderly people and to improve their mobility thanks to the exergame.

Equally, some subsets of the DOREMI system are ready to get to the market: 'We consider the possible exploitation of the social and gamified environment, the monitoring environment and the context-aware smart system,' Prof Parodi says. The reference market for DOREMI technologies includes hospitals, social care providers, end users, local authorities, insurance companies, general practitioners and social housing.

DOREMI

- ★ Coordinated by the National Council of Research in Italy.
- ★ Funded under FP7-ICT.
- ★ http://cordis.europa.eu/project/rcn/110829
- ★ Project website: http://www.doremi-fp7.eu



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STUDY FINDS THAT THE TIME OF DAY INFLUENCES SUSCEPTIBILITY TO INFECTION

EU-funded research has found that we are more susceptible to infection at certain times of the day as our natural body clock affects the ability of viruses to replicate and spread between cells.

The findings stem from the University of Cambridge-based METACLOCK (Metabolic oscillations and the 24 hour (circadian) clockwork) project and were published on 15 August in the 'Proceedings of the National Academy of Sciences'. Importantly, they may help to explain why shift workers, whose body clocks are routinely disrupted, are more prone to health problems, including both infections and chronic disease.

Following infection by a virus, the virus hijacks the body's machinery and resources found within cells to help it replicate and spread throughout the body. However, the resources available to facilitate the virus' ability to replicate fluctuate throughout the course of the day. This is partly in response to our circadian rhythms, in effect, our body clock. Circadian rhythms control many aspects of our physiology and bodily functions, ranging from sleeping patterns to body temperature, and from our immune systems to the release of hormones. These cycles are controlled by a number of specific genes, which include Bmal1 and Clock.

To test whether the human body is more susceptible to infection at certain times of the day, the Cambridge researchers compared normal 'wild type' mice infected with the herpes virus at different times of the day, measuring the levels of virus infection and its spread through the body. The mice lived in a controlled environment where 12 hours were in daylight and 12 were dark.

They found that virus replication in mice infected at the very start of the day (equivalent to sunrise, when these nocturnal animals start their rest phase) was 10 times greater than mice infected 10 hours into the day, when they transition to their 'active' phase. When the research team repeated the experiment in mice lacking the Bmal1 gene, they found high levels of virus replication regardless of the time of infection.

'The time of day of infection can have a major influence on how susceptible we are to disease, or at least the viral replication, meaning that infection at the wrong time of day could cause a much more severe acute infection,' commented Professor Akhilesh Reddy, the study's senior author. 'This is consistent with recent studies which have shown that the time of day that the influenza vaccine is administered can influence how effectively it works.'

Additionally, the research team found similar time-of-day variation in virus replication in individual cell cultures, without influence from the immune system. Abolishing cellular circadian rhythms increased both herpes and influenza A virus infection, a dissimilar type of virus (known as an RNA virus) that infects and replicates in a substantially different manner to herpes.

'Each cell in the body has a biological clock that allows them to keep track of the time and anticipate daily changes in our environment,' said first author Dr Rachel Edgar. 'Our results suggest that the time clock in every cell determines how successfully a virus replicates. When we disrupted the body clock in either cells or mice, we found that the timing for infection no longer mattered — viral replication was always high.'

Armed with these findings, the research team have suggested that shift workers, due to working on some nights and then resting on others, could be prime candidates for receiving the annual flu vaccines.

As well as the daily cycle of activity, Bmal1 also undergoes seasonal variation, being less active in the winter months and increasing in summer. This has led the research team to speculate that this is the reason why certain diseases, such as influenza, are more likely to spread through the general population during the winter months.

Finally, the research team also discovered that herpes viruses are able to manipulate the molecular 'clockwork' that controls the body's circadian rhythms, allowing the virus to spread faster and further. This is a process similar to the one used by the malaria parasite, which is known to synchronise its replication cycle with the host's circadian rhythm, allowing for a more successful infection.

The METACLOCK project received around EUR 2 million from the European Research Council (ERC) and was due to conclude in September 2016.


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METACLOCK

- Hosted by the University of Cambridge in the United Kingdom.
- Funded under FP7-IDEAS-ERC.
- http://cordis.europa.eu/news/rcn/126025

SOCIAL SCIENCES AND HUMANITIES

TAKING A SOCIAL APPROACH TO BETTER UNDERSTAND A COMPLICATED HISTORY

Viewing history through the prism of traditionally unexplored social fields, EU-funded researchers pull back the curtain on what really caused the fall of communist regimes in Central and Eastern Europe.

Although it is widely understood that the communist regimes of Central and Eastern Europe disintegrated starting in 1989, what isn't widely understood — or perhaps is even misunderstood — is the 'why'. To shed light on what really happened, the RESOCEA (Regime and Society in Eastern Europe (1956 - 1989). From Extended Reproduction to Social and Political Change) project looked beyond the historic tradition of viewing the era through a comparative political lens in favour of trying to better understand the social dynamics and social change happening in Central and Eastern Europe during that volatile time.

The project set out to revise the traditional view of regime and society in communist countries by recounting history through the prism of such unexplored social fields as the clash between science and ideology, industrial accidents, the migration process, international mobility, generational and culture clashes, and the contradiction between the drive for economic effectiveness and ideological bias.

Researchers explored the relationship between the communist regime and society using an innovative methodology that focused on what they refer to as the 'concept of the incident' within the framework of status-events and the 'Big Event'. 'A key challenge — which turned out to also be a key factor to our success — was to channel and interpret the abundance of empirical material we had at our disposal to connect the individual stories and facts at the micro-level with macro social phenomena and explanations,' explains RESOCEA principal investigator Professor Ivaylo Boyanov Znepolski.

With Prof. Znepolski taking the lead, he was supported by four senior researchers from former communist countries. Each researcher took on a specific country, looking into the local aspects of the fall of the communist regimes. At the conclusion of their research, a comparative narrative linking all five case studies was published.

Myth busters

One of the key findings coming from the project was the debunking of several popular myths. For example, it has been long held that the collapse of communism in Central and Eastern Europe was unexpected, and that the people of the former Soviet-bloc countries viewed freedom as a gift. 'What we found is conclusive proof that nothing about 1989 was "unexpected" and, in fact, the opposite was true,' says Znepolski. 'When you view all five case studies together, it becomes clear that change is a continuous process, and that the so-called Big Event of 1989 itself was not a game-changer, but simply a way for history to identify, or give a name to, the change.'

Another surprising finding from the project was that, contrary to popular belief, the communist regimes of Central and Eastern Europe did not enforce complete control over society. Based on their in-depth analysis of day-to-day life under communism, RESOCEA researchers revealed the existence of a branched-out network of micro-power centres, each of which was able to successfully loosen various areas from the allegedly iron-clad grip of the communist regimes.

The Achilles' heel

So if it wasn't sudden change or resistance to total governmental control, what did cause the fall of these regimes?

According to Znepolski, the communist system suffered one key anthropological defect: its failure to incentivise individuals to take the initiative and develop their creative talents. This was the push that started the dominoes falling. 'This one factor caused consistent tensions between the

individual and the system and, at the end of the day, resulted in the regime losing the support of its own initial powerbase — the people in whose name it had come to power by and who should have directly benefited from its reign,' says Znepolski.

Add to this building of nonconformist behaviour, the increasing popularity of unofficial publicity channels, and an array of change and social transformation happening across all parts of society, and what may have looked like nothing more than clouds on the horizon converged to form the perfect storm — taking down the communist regimes in its wake.

RESOCEA

- ★ Coordinated by Sofia University in Bulgaria.
- ★ Funded under FP7-IDEAS-ERC.
- ★ http://cordis.europa.eu/news/rcn/125962
- ★ Project website: http://resocea.uni-sofia.bg/

AUSTERITY CRISIS PROTESTS: IRELAND VS. SPAIN

An in-depth look at how citizens in Ireland and Spain demonstrated against austerity sheds new light on the role of technology in civil protests.

In recent years, the spectre of austerity has hit many a European nation, undermining economic growth and creating challenges for citizens at many different levels. The EU-funded CPAA (Contentious Politics in an Age of Austerity: A comparative study of anti-austerity protests in Spain and Ireland) project cross-compared austerity in two very different nations, namely Ireland and Spain.

In an effort to understand the impact of austerity, the project team conducted paired comparisons and identified independent variables to explain differences in political opportunity structures. It employed process tracing to articulate explanations and hypotheses that can be tested in other cases.

More specifically, the project studied mobilisation against the crisis and the role of 'Information and communications technology' (ICT) in mobilising people. It found that culture plays a much larger role than technology in adopting and using digital tools, noting that the role of ICT in providing organisational infrastructures is often overstated. Nonetheless, the team found that factors such as deprivation, propensity to mobilise, outrage and perceived grievances were much less important in challenging austerity than mobilisation based on pre-existing networks and facilitated by effective use of digital media.

While protesters stayed longer on the streets of Dublin than they did in Madrid, the latter were more organised and exploited pre-existing networks to gain participants. The Madrid camp evolved into more long-term initiatives and transformed public opinion in Spain, while the Dublin camp did not. In effect, the team concluded that

"While protesters stayed longer on the streets of Dublin than they did in Madrid, the latter were more organised and exploited pre-existing networks to gain participants."

understanding anti-austerity mobilisations should not rely only on evaluating intensity and frequency of protests. Instead, it should rely more on assessing social movement networks, shared discursive frameworks and strategies, and the communities involved.

Overall, the project revealed valuable insight through research and case studies on anti-austerity protests in Spain and Ireland. It published several articles and a monograph on the topic, disseminating interest in academic and political circles even beyond Europe. In our economically volatile world, this knowledge could prove useful in managing civil unrest in times of crisis.

CPAA

★ Coordinated by the National University of Ireland Maynooth in Ireland.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/188626

IMPACT OF COUNTER-RADICALISATION POLICIES ON MULTICULTURALISM IN EUROPE

Governments throughout Europe are developing strategies aimed at preventing radicalisation to terrorism. But do these policies have unwanted effects? An EU initiative explored the impact of counter-radicalisation on citizenship and discrimination.

Media and politicians in European countries have announced the 'end' of multiculturalism. The main reason, they argue, is the need to tackle 'homegrown terrorism', a danger presented the result of ghettoization and ethnic and religious separateness. Counter-radicalization policies, which have been developed in European countries since the mid-2000s, therefore centred around social cohesion and community resilience. Yet research shows that they might generate the opposite effect.

The EU-funded COUNTERADICAL (Security and the politics of belonging: Homegrown terrorism, counter-radicalisation and the 'end' of multiculturalism?) project argued that current counter-terrorism strategies increasingly polarise European societies along ethnic and religious lines.

Using existing literature as a basis and comparing Great Britain, France and the Netherlands, the project explored the hypothesis that counter-radicalisation policy does not mark a return to assimilation policies. To achieve this, it mapped discussions and social stances to understand how counter-radicalisation policies targeting communities and ethnic groups have developed and continue to be maintained. Counter-radicalisation practices such as surveillance, ethnic and risk profiling, biometric identification and community policing methods were analysed through interviews, focus groups and ethnographic observation.

"Even though politicians might anticipate electoral gains from an assimilationist stance, this is not shared by security professionals."

The COUNTERADICAL project dealt with questions surrounding the contradiction between politics and media and counter-radicalisation practices, and how these practices in turn function with respect to diversity and citizenship issues. The impact of these policies on target groups was also investigated.

The project found that even though politicians might anticipate electoral gains from an assimilationist stance, this is not shared by security professionals, which increasingly enjoy a high level of autonomy and legitimacy.

The research showed that by routinely functioning along ethnic and religious lines, counter-radicalisation methods and techniques reinforced such practices. Instead of promoting assimilation, counter-radicalisation policies create and strengthen a part of society into discrete ethno-religious groups.

COUNTERADICAL

★ Coordinated by Leiden University in the Netherlands.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/188551


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Making the EU's online environment more secure

A new CORDIS Results Pack has been released in October 2016 during the annual European Cybersecurity Month.

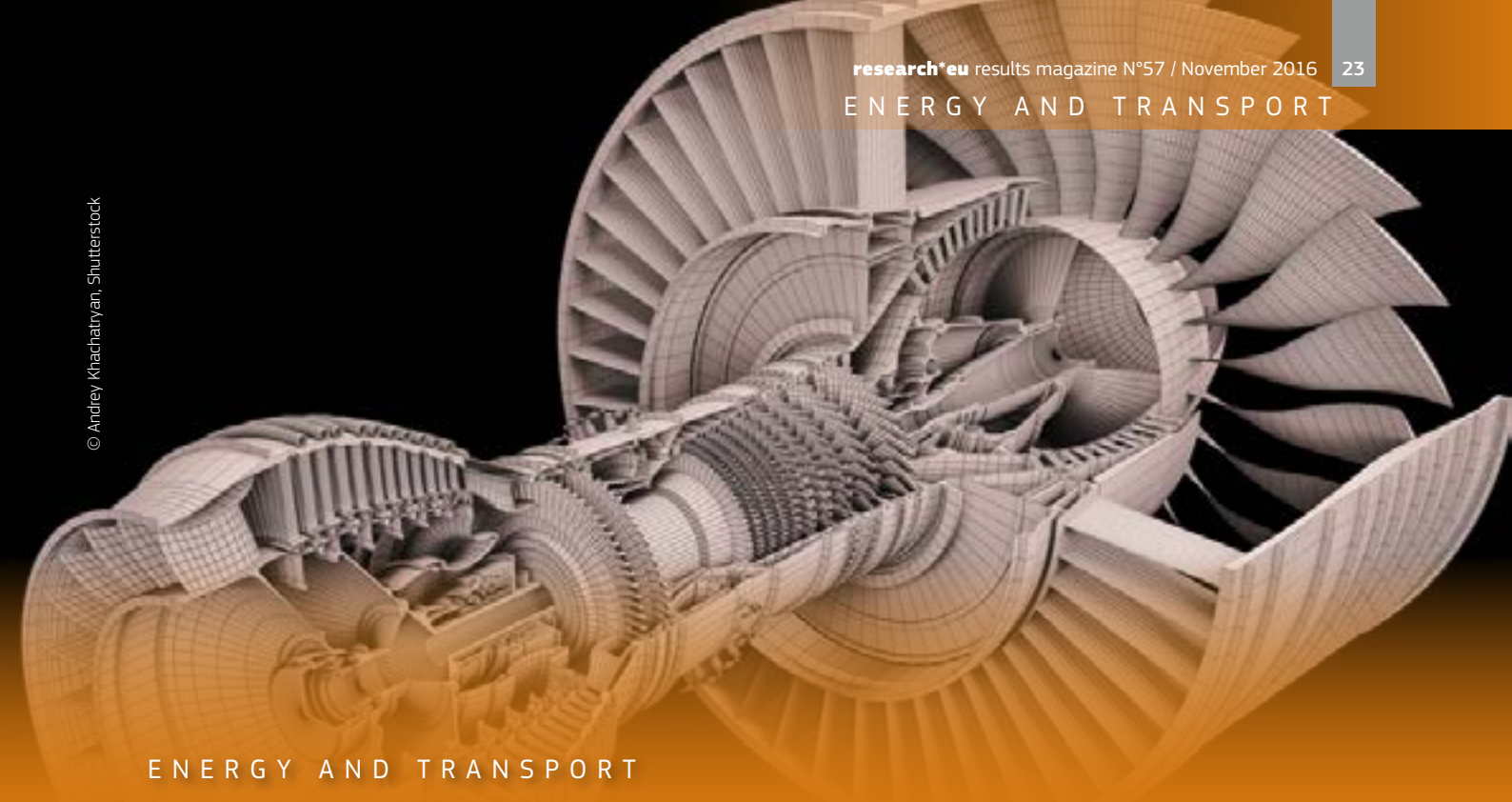
It follows the European Commission's adoption in July 2016 of a set of measures to strengthen Europe's cyber resilience and boost the overall competitiveness of the cybersecurity industry, including a contractual public private partnership (cPPP) that will advance a cutting-edge European research and innovation agenda, with up to **EUR 450 million of funding from Horizon 2020.**

The CORDIS Results Pack will showcase some of the most promising EU-funded projects already engaged in developing novel solutions to combat an ever-increasing number of cybersecurity threats to Europe's critical infrastructures. Be sure not to miss it!

Contact **CNECT-CYBERSECURITY@ec.europa.eu** to be alerted when the Results Pack goes online or find out more about the European Commission's support for cybersecurity at: **https://ec.europa.eu/digital-single-market/en/cybersecurity** and **https://cybersecuritymonth.eu/**

About CORDIS Results Packs

CORDIS Results Packs are a new set of products grouping EU-funded project results per topic and target audience. The aim is to disseminate information about new studies, scientific findings and technologies to the relevant target audience, in order to facilitate their exploitation across Europe.



ENERGY AND TRANSPORT

NEW TESTS ON AIRCRAFT EMPENNAGE DESIGNS

Integration of advanced turbofan engines at the rear fuselage of an aircraft requires a re-thinking of the fuselage design, especially in view of noise shielding issues. An EU-funded project evaluated the potential of several designs to reduce noise through extensive wind tunnel tests with major implications for future aircraft design.

A test campaign involving two dedicated aeroacoustic and aerodynamic wind tunnel tests was carried out at low speed under the PLAAT (Aeroacoustic and aerodynamic wind tunnel tests at low speed for a turbofan model equipped with TPS) project. It was conducted at the Large Low-speed Facility of the German-Dutch Windtunnels (DNW-LLF) in the Netherlands for a turbofan model equipped with up to two 'Turbine powered simulators' (TPS) engines. An important milestone for Smart Fixed Wing Aircraft was reached. The tests were performed using a model of a business jet configuration incorporating a U-shaped empennage. The aircraft model was manufactured within the context of another EU-funded project called LOSPA. One TPS engine was provided by ONERA, the other by DNW.

The first part of the campaign was dedicated to aerodynamics and was carried out in the 8x6 m^2 closed test section of the LLF wind tunnel. The objective was to study the aerodynamic interaction of various tail configurations with the jet exhaust of the two TPS engines.

The second part was dedicated to aeroacoustics and was performed in the 8x6 m^2 open jet test section of the LLF wind tunnel. Three lines of far-field microphones and a 4x4 m^2 large phased microphone array outside of the flow were applied for the evaluation of noise shielding of the U-shaped tails with a single-powered turbofan simulator installed on the LOSPA model. The acoustic near-field was investigated by four arrays of instantaneous pressure sensors inside the TPS nacelle. For airframe noise measurements with the unpowered model, the TPS was replaced by a through flow nacelle. For reference and calibration purposes, the acoustic characteristic of an isolated TPS, installed in a specially made support, was also measured under wind-off and wind-on conditions.

"The tests were performed using a model of a business jet configuration incorporating a U-shaped empennage."

PLAAT's tests are a critical step towards the development of future business jet aircraft and the design of engines over horizontal tail configurations.

PLAAT

★ Coordinated by DNW in the Netherlands.
★ Funded under FP7-JTI.
★ http://cordis.europa.eu/result/rcn/183212

MEASURING CREEP IN POWER STATION COMPONENTS

Components operating over long periods in high temperature environments, such as power stations, are subject to deformation through creep. As more than two thirds of European power stations are over 20 years old, it is important to employ inspection techniques that can detect creep before extending their working life.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'Digital image correlation' (DIC) is a non-contact technique for assessing materials and structural integrity. However, for DIC to be applied to 'High temperature creep' (HTC), two problems must be overcome: the long-term stability of the speckle pattern and the accuracy of the measurement system.

The HTCSENSOR (Development of a portable 3D deformation sensor for high temperature creep measurement) project addressed these challenges by developing an HTC sensor and associated algorithms for measuring creep strain and estimating the remaining life of the component.

Researchers developed an HTC sensor that comprised a protective mechanism and a measurement device. Inert argon gas was used to fill the sealed space to protect the materials from oxidation and other contamination. A silver ring (rather than the commonly used copper O ring) was used to ensure the mechanical sealing worked over a prolonged period of time.

Micro indentations were produced on the inspection area of the steam pipe, thereby acting as a speckle pattern for the DIC. The inert gas and the mechanical sealing ensured that the speckle pattern maintained its stability throughout the sensor's working life.

A camera deployment mechanism was also developed, which could be quickly positioned on the mechanical sealing device. This ensured stability of the measurement system, without the need for a camera to be in place all the time.

In addition, remaining life assessment algorithms were developed based on mechanical damage models and were calculated from both the instant creep strain rate and the accumulated strain. The results were fed into the remaining life assessment module, thereby enabling scientists to evaluate the remaining life of the components subject to high temperature.

Finally, the project developed a DIC software package that incorporated advanced algorithms for digital image correlation for measuring deformation and improving accuracy and speed of measurement.

Since creep is characterised over the long term at high temperature, it will take several years to fully demonstrate the HTC sensor developed. However, preliminary results have shown that the HTC sensor and system have successfully met the requirements for pipeline creep measurement at high temperature.

HTCSENSOR successfully solved the fundamental problem of oxidation in high temperature creep measurement using DIC in a power station. The system therefore has enormous potential for application in the power generation sector and in chemical processing plants.

HTCSENSOR

- ★ Coordinated by TWI in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/188391

HYDROGEN BIOFUEL FROM SUNLIGHT

Better and more cost-effective artificial photosynthesis systems have been investigated by an EU-funded initiative. The aim was to capture and store solar energy in the chemical bonds of a fuel, thereby providing a sustainable form of renewable energy for the future.

Sunlight can provide a possible energy source for the production of hydrogen by splitting water into its constituent elements through artificial photosynthesis. European researchers used a new approach that integrated semi-conductor nanomaterials with catalytically active biological enzymes to reduce protons to hydrogen in an aqueous electrolyte exposed to sunlight.

The initial objective of the 1DH2OP (Coupling of one-dimensional TiO_2 with hydrogenase: simultaneous visible-light driven H_2 production and treatment of an organic pollutant) project was to advance the use of enzyme-electrode materials. This was based on two enzymes, 'Photosystem II' (PSII) for water oxidation and hydrogenase for proton reduction.


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The project's second objective was to develop a strategy to immobilise hydrogenase on a p-Si photocathode for hydrogen production, enabling the development of an enzyme-based tandem photoelectrochemical cell. This enabled the development of an unassisted photocatalytic system for splitting water molecules using sunlight.

In addition, researchers investigated two simultaneous processes for 'hydrogen' (H_2) production and 'carbon dioxide' (CO_2) reduction via a bacterial formate hydrogenlyase complex. These developments led to the design of novel artificial biomimetic systems for bioenergy applications.

Project partners successfully assembled the enzyme-based bio-hybrid photoelectrochemical cell, enzyme-based photocathodes and enzymatic processes with simultaneous H_2 production and CO_2 reduction. This demonstrated the versatility of biological enzymes when coupled with inorganic and semi-conductor materials.

Direct coupling of PSII to hydrogenase was shown to be an efficient route for photo-biological H_2 production. Advances in the PSII photoanode interface are expected to result in further improvements in light-to-product conversion efficiencies.

Titanium dioxide (TiO_2) was used as a protective layer and efficient interfacial layer for hydrogenase immobilisation. It also provided a viable platform for linking the enzyme to a p-type semi-conductor in order to perform light-driven proton reduction in catalytic reactions. Further improvements could be made to the interfacial layer by applying a thin layer of TiO_2 using the atomic layer deposition method.

The work carried out by 1DH2OP on formate hydrogenlyase demonstrated an outstanding system whereby enzymes can react to carry out H_2 production and CO_2 reduction within a single complex. Therefore, the biomimetic system developed can be used for biofuel H_2 production. This will help to increase the competitiveness of the European Research Area in renewable energy research and mitigate climate change.

1DH2OP

- ★ Coordinated by the University of Cambridge in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/183225

MINUSCULE STRUCTURES PROMISE BIG EFFICIENCIES

EU-funded researchers working on enhancing the efficiency of photovoltaic cells wanted to convert as many of the sunlight wavelengths as possible; otherwise only a tiny bit of incoming energy can be used.

'Silicon' (Si), the current photovoltaic industry standard, is limited in the wavelength range it can 'see' and absorb. However, when strained Si is irradiated with light ions, miniscule voided structures are formed. These nanodots and nanovoids exhibit electronic and optical properties that had not been hitherto investigated in photovoltaic applications.

"They created such plasmonic structures in a unique photovoltaic device configuration made of 'Si-tin' (Sn) and Si layers put together."

Researchers initiated the NOVOSIP (Nano-voids in strained silicon for plasmonics) project to explore the use of nanodots and nanovoids to enhance the efficiency of single-crystalline Si photovoltaics. To this end, they created such plasmonic structures in a unique photovoltaic device configuration made of 'Si-tin' (Sn) and Si layers put together.

Nanodots and nanovoids were placed in the highly doped emitter layer close to the p-n junction in order to extend near-field effects. These effects were expected to contribute to carrier multiplication and increase light scattering, both promising to enhance sunlight absorption. Researchers then used different methods to investigate the structural, optical and electronic properties of each layer.

Through high-temperature ion irradiation of the Si/SiSn/Si structure, the NOVOSIP team obtained spherical nanovoids in nanometre-sized strained Sn precipitates. With carbon ion implantation and subsequent thermal treatment, they observed carbon nanoflakes being formed. The flakes' crystalline structure allowed the absorption of all light wavelengths, potentially increasing the energy conversion rate.

An innovative concept was also proposed and demonstrated for the self-assembly of metallic nanoshells in the strained Si/SiSn/Si structure. The results of theoretical investigations and numerical simulations reproducing different effects of plasmonic resonance helped the researchers to distinguish their contribution to the experimental observations.


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NOVOSIP work, although at an early stage, represents a promising path forward for single-crystalline Si solar cell research. The miniscule plasmonic structures engineered in strained Si multilayers enable enhanced light harvesting at low cost. Moreover, potential applications are already foreseen in gas-sensing and light-emitting devices.

NOVOSIP

- ★ Coordinated by the Belarussian State University in Belarus.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/188388

ENVIRONMENT AND SOCIETY

FOREST FRAGMENTATION A DANGER TO VULNERABLE SPECIES

Research stemming from the EU-funded TERRAGEN project has found that forest fragmentation has prompted a decline in species sensitive to changes in light, moisture and temperature.

Publishing in the journal 'Biological Conservation', the research team have warned that breaking up the rainforest into 'forest islands' is resulting in more species having to live closer to the forest edge and that many are failing to adapt to such a changed environment.

Studying over 100 species of reptiles and amphibians living in nine fragmented forest landscapes in Central and South America, they found that 90% of all species were affected by the 'forest edge effect'. Whilst a small number of species actually increased in abundance (due to having already adapted to living at the forest edge), the majority of species declined and the negative impact on them also extended far into the forest interior.

Sampling in areas where the forests had been divided up to make way for farming or roads, the TERRAGEN (Terragenesis: Using landscape ontogeny to predict the persistence of species) research team, led by Newcastle University, UK, showed the average edge effect extended more than 250 metres into the forest. Consequently, this means that a forest island with a diameter of less than 500 metres would contain no viable 'core' area for many forest species. Now the researchers are calling for a new approach to forest conservation and management.

'The rapid decline in the world's rainforests is having a devastating effect on species numbers and diversity, but until now there has been little information about the additional impact of forest fragmentation,' commented Dr Marion Pfeifer, one of the lead authors of the study. 'In our study, we found the majority of amphibian and reptile species were negatively impacted the closer we got to the forest edge, and in some cases, species disappeared altogether. The findings have strong implications for conservation in fragmented tropical landscapes and suggest large forest patches will need to be conserved to protect forest-dependent species and avoid loss of biodiversity.'

In the Brazilian Atlantic forest, more than 80% of the fragments are less than 50 hectares, and half of the remaining forest is closer than 100 metres to an edge, much smaller than the minimum needed to preserve species diversity. 'These "edge zones" differ structurally and functionally from the original forest,' explained Dr Pfeifer. 'Edges are typically characterised by more open canopies, leading to reduced moisture and increased light, wind and maximum daily temperatures. This compares to the core where the dense canopies can filter up to 95% of the solar radiation and the environment is more consistent.' She pointed out that some species, particularly reptiles and amphibians, are more sensitive than others to changes in the microclimate, thus negatively impacting their chances of survival in the edge zone.

Amphibians are the world's most threatened group on the IUCN Red List of threatened species, the world's most comprehensive source on the global conservation status of animal, fungi and plant species. The TERRAGEN research team assessed the abundance of 104 amphibian species and reptiles in nine fragmented regions in the Neotropics and found that only two amphibians and eight reptiles were not sensitive to the edge effect.

Now the team is looking at the impact of forest fragmentation on other species, from insects and birds to mammals, and how

this could be used to inform future conservation efforts and management strategies in fragmented forest landscapes. For this, the team will actively use an extensive dataset compiled within the Global Biofrag project, which is also led by Dr Pfeifer.

'Road expansion is a key priority for communities in this part of the world, so this research will be vital in helping to inform future management plans,' she says. 'Amphibians and reptiles are useful indicator species for assessing the overall health of the forest ecosystem, and the next step will be to work with local communities to see how we can best protect biodiversity under conflicting land demands.'

TERRAGEN

★ Hosted by Imperial College of Science, Technology and Medicine in the United Kingdom.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/news/rcn/126000

HOW TO ACHIEVE A GREENER, HEALTHIER INDOOR ENVIRONMENT

'Heating, ventilation and air conditioning' (HVAC) have a major impact on indoor air quality and are responsible for almost 33% of the energy used in commercial facilities. This phenomenon was examined by an EU-funded initiative that developed new duct technology, introducing new cleaning and maintenance methods based on the cost-effective application of nanotechnology.

Many people spend long periods of time inside commercial and public buildings where only 10-15% of the air may be fresh, with the remaining portion being recirculated, often for efficiency reasons. Unfortunately, exposure to low-quality air can lead to the increased presence of allergies and even respiratory diseases. The NANO-HVAC (Novel nano-enabled energy efficient and safe HVAC ducts and systems contributing to a healthier indoor environment) project used a dual approach to improve conditions in buildings.


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The first approach involved the development of safe, highly insulating HVAC ducts that minimise loss of heat and cooling. Cost-effective, safe and extremely thin insulating duct layers were obtained using aeroclay-based insulation foams that can be automatically applied during manufacturing. Such technologies can achieve a 50% saving in energy losses and a reduction of 45% in the duct cost, as compared with conventional insulated ducts.

The second approach involved the removal of pathogens and allergens during operation and maintenance to reduce microbial growth. Project partners developed an antimicrobial, antifungal and antiallergenic sprayable and self-adhesive coating based on titanium oxide nanoparticles. This can be applied to HVAC filters during manufacture or while they are *in situ*. Furthermore, the use of a low-energy ultraviolet light-emitting dioxide system will not increase HVAC energy consumption by more than 1%.

Researchers also developed an injectable liquid polymer matrix comprising epoxy resins with polyamine-derived crosslinking catalysts, which contained antimicrobial nanoparticles of silver oxide. This was used for air ducts' *in situ* maintenance where the liquid polymer creates a coating that covers the surface, trapping dirt, debris and microorganisms and thereby generating the duct's inner layer. The procedure can be repeated many times without compromising HVAC energy performance.

NANO-HVAC successfully employed antimicrobial and antiallergenic solutions to improve the indoor environment. The system can dramatically improve air quality in buildings, thus improving people's health and well-being, and produce significant energy savings. It will also help make Europe a leader in state-of-the-art HVAC systems.

NANO-HVAC

★ Coordinated by Vento in Belgium.
★ Funded under FP7-NMP.
★ http://cordis.europa.eu/result/rcn/183147

UNDERSTANDING THE CONSEQUENCES OF CLIMATE CHANGE MITIGATION POLICY

EU-funded research shows that when climate change policy focuses only on mitigation without considering adaptation costs and residual damages, unintended inequalities result.

Although the Paris Agreement on climate change represents an important step forward in international climate policy, like most climate policy, its analyses focus primarily on mitigation (i.e. national climate pledges, long-term temperature targets, etc.). However, this focus on mitigation comes at the expense of such considerations as adaptation costs and residual damages. When climate change policy fails to consider these important factors, the result is often regional unfairness in the implementation of mitigation efforts.

"The study proved that the distribution of damages and adaptation costs remain unequal, even under a two-degree stabilisation policy, such as the one adopted by the Paris Agreement."

Currently, there are only a few studies that have analysed emission allowance allocation schemes in which mitigation costs, adaptation costs and residual damages are all considered. One such study was carried out by Italy's Fondazione Eni Enrico Mattei (FEEM), together with the Netherlands Environmental Assessment Agency (PBL). Their recently published results, which were produced within the context of the LIMITS (Low climate IMpact scenarios and the Implications of required Tight emission control Strategies) project, highlight the possible consequences of climate change mitigation and adaptation policies on global inequalities.

The LIMITS project conducted a rigorous assessment of what a stringent climate policy entails and what is required to overcome major impediments. Using the latest methodological instruments and technology, it assessed climate policies via mitigation and adaptation scenarios and evaluated the 'big picture' implications of today's climate change initiatives. The LIMITS approach to understanding climate policy allows policymakers, including those at the Paris Climate Change Conference, to better assess both costs and benefits of aggressive climate targets. It also served as the foundation of the FEEM/PBL study.

A broader view of equity

The study proved that the distribution of damages and adaptation costs remain unequal, even under a two-degree stabilisation policy, such as the one adopted by the Paris Agreement. The study reached this conclusion by utilising two integrated assessment models to examine five emission reduction policy scenarios. It also compared three effort sharing schemes for distributing the global mitigation effort: greater mitigation effort where costs are lower; distribution of the mitigation effort to equalise regional mitigation costs; and distribution of the mitigation effort to equalise total climate costs.

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From this work, researchers discovered that by not examining damages and adaptation, one actually risks further increasing the inequalities that already exist as a result of the mitigation policies. Based on these findings, researchers concluded that a global carbon market and international emission trading scheme could, in theory, compensate the countries most affected by these mitigation efforts. However, to do so, such an instrument would require a broader view on equity that explicitly considers the regional disparities in total climate costs — including damages and adaptation.

The study also states that additional financial transfers must compensate for residual damages and adaptation costs. Yet researchers note that doing so will be a challenge. For example, the Paris Agreement calls for an ambitious mitigation policy to stabilise global average temperature increases below two degrees Celsius compared to pre-industrial levels. But according to researchers, accomplishing this will see residual damages and adaptation costs rise to such levels as USD 500 billion by 2050.

Adopting adaptation

Needless to say, climate policy equity considerations should take into account all cost items associated with climate change. The good news is that research like the LIMITS project is moving the global climate change discussion in the right direction. In fact, for the first time, the Paris Agreement includes adaptation as one of its long-term, global goals.

LIMITS

- Coordinated by FEEM in Italy.
- Funded under FP7-ENVIRONMENT.
- http://cordis.europa.eu/news/rcn/125980
- Project website: http://www.feem-project.net/limits/

LAGOON MANAGEMENT PLANS DEVELOPED

A consortium of researchers and local authorities has developed management plans for 10 lagoons around Europe. The effort is aimed at helping these vulnerable ecosystems deal with climate change.

Located between land and sea, lagoons and estuaries mark the transition from freshwater to seawater. These dynamic and productive environments are increasingly under threat from urbanisation, industry, agriculture and recreational use. They also face the growing impacts of climate change.

"The ARCH initiative developed roadmaps for implementing solutions, which will involve all the local actors."


© Gijsbert D. Breedveld

The ARCH (Architecture and roadmap to manage multiple pressures on lagoons) project worked with policymakers, local authorities and researchers to manage the challenges facing lagoons and estuarine coastal areas. The consortium conducted case studies at 10 selected lagoons and estuaries across Europe.

At each site, project partners used workshops to develop a decision-making framework for managing current and future challenges. This was achieved by examining the social, economic and ecological states of the lagoon and linking them to a spatial planning methodology.

The framework was used to draw up a state-of-the-lagoon report for each of the 10 case study sites, taking a step towards individual management plans by identifying multiple and combined problems. During the process, policymakers, scientists and managers were involved and invited to select the relevant solutions.

From these reports, the ARCH initiative developed roadmaps for implementing solutions, which will involve all the local actors. In addition, it produced a management guide for coastal managers and policymakers as well as a European lagoon management handbook.

ARCH also conducted Evaluation and Instruction workshops that involved international scientists and other relevant parties external to the project. Finally, two international conferences and a website disseminated the results to global audiences.

Ultimately, the project's findings will be used to create applicable solutions to protect lagoon ecosystems and preserve Europe's natural heritage.

ARCH

- Coordinated by NGI in Norway.
- Funded under FP7-ENVIRONMENT.
- http://cordis.europa.eu/result/rcn/92764

IT AND TELECOMMUNICATIONS

CLOUD INNOVATIONS SIGNAL THE FUTURE FOR URBAN MOBILITY

A groundbreaking EU project has delivered a cloud-based platform along with a range of apps and tools to help get European cities moving sustainably.

Whilst cities across Europe are waking up to the economic, social and environmental benefits of sustainable urban transport, communicating to citizens the options that are available remains a challenge. In order to address this, an existing cloud-based platform has been combined with new functionalities to enable local authorities and businesses across Europe to provide cutting edge online services for citizens and customers.

The EU-funded ECIM (European Cloud Marketplace for Intelligent Mobility) project, launched in January 2014, has built upon the success of the European Platform for Intelligent Cities (EPIC) to create a marketplace for transport solutions. This is a place where service providers, data providers and developers can come together and co-create innovative applications for citizens.

The platform taps into the potential of cloud computing, which is about sharing computing resources rather than having local servers or personal devices handle each individual application. This is a highly efficient means of delivering services, and offers end users potentially unlimited resources for their applications on an on-demand basis. Mobility was used as a validation scenario, as these services can be easily migrated to cloud infrastructure and are consistently cited as high priorities by citizens and public service providers alike.

Throughout the project, 14 partners from five European countries worked collectively and in cooperation with other actors, such as mobility service providers and public authorities, to enable cities and business to easily migrate their services to the cloud and to facilitate new service creation. Pilot projects were carried out in Barcelona, Paris and Brussels. The project also sought to encourage the cross-border adoption of cloud-based services in Europe and beyond.

For example, by merging real-time management of on-street and off-street parking availability with public sector transport options, cloud-based platforms enable cities to encourage more environmentally friendly modes of transport and save citizens time. As the project developed, new services were added, including car and bike sharing options and 'electric vehicle' (EV) charging stations. When the project was officially completed in June 2016, ECIM resembled a truly multi-modal solution, capable of addressing the mobility needs of a contemporary city.

Once this platform was up and running, a set of common 'Application programme interfaces' (APIs) was promoted through the SmartMobility.io initiative. These APIs sought to standardise the ways in which mobility services could be made available to developers, and represented an important step towards the creation and subsequent improvement of the apps tested in the three pilot cities. They provide a framework for harmonising custom API formats used by different mobility service providers, and allow developers to create new, innovative apps for cities and citizens.

Some of these mobility apps were co-designed and tested in the three test cities. These multimodal apps combine a range of different mobility services, from parking and payment, to public transport and bike sharing, and the ones in Brussels and Paris include a single-sign-on functionality, allowing users to access and pay for parking services of different providers using a single user account.

Sustainability workshops were also held to streamline views on the most suitable business model for ECIM, as well as to find consensus on how to take the first steps toward commercialisation following the project's completion. Many partners have expressed strong interest in taking ECIM to the next level, which includes — but is not limited to — the creation of a company focused on smart mobility.

ECIM

- ★ Coordinated by iMinds in Belgium.
- ★ Funded under CIP.
- ★ http://cordis.europa.eu/news/rcn/125979
- ★ Project website: http://www.ecim-cities.eu
- ★ http://bit.ly/2e3Sm47

EU PROJECT SOLVES THE MYSTERY OF NETFLIX'S CONTENT DELIVERY NETWORK

Netflix is the undisputed champion of Internet video providers but has never actually had to build its own datacentres. So it hardly comes as a surprise to see engineers across the world craving to find out how the company can withstand such traffic whilst avoiding video stalling during playback. The ENDEAVOUR project team has made this dream come true by finding out how these servers work — and from where.

With online video content currently accounting for half of web traffic and rich content applications sprouting everywhere, the team's findings — which notably reveal that Netflix's 'Content delivery network' (CDN) spans 233 sites across six continents — are crucial. They hint at how Internet infrastructure will evolve to address future capacity issues, expose the diversity of the Internet ecosystem worldwide, and suggest that the specifics of each region's ecosystem and market should lead to different development strategies.

"This study highlights the importance of the still vastly underappreciated IXP ecosystem."

Different location, different strategy

In April and May 2016, the five-researcher team from Queen Mary University of London (QMUL) requested videos from university computers, localising the requests using a browser extension. They studied the traffic delivered by the servers in each region, eventually highlighting the relative reliance on servers of 'Internet exchange points' (IXPs) and 'Internet service providers' (ISPs).

Their findings revealed significant differences in Netflix's network between countries and continents: whilst in North America Netflix is present in many locations simultaneously, in Europe, their servers are deployed at only a few locations per country. The UK comes out as a notable exception to that rule, as the situation there is more similar to that of North America.

When studying these differences, the team noticed that IXP locations tend to rely on a significant number of servers at few locations, whilst ISP deployments are smaller in size but often at many locations. They also found that the sheer size of the deployments reflected the various markets of Netflix quite well.

'The study is important as it provides an insight into how today's Internet works,' said Timm Boettger, first author of the study supported by the EU-funded ENDEAVOUR (Towards a flexible software-defined network ecosystem) project. 'The different deployment strategies observed are caused by inherent regional differences, forcing Netflix to adapt its strategy to ensure low movie start-up times and to avoid video stalling during playback. These differences are caused not only by how well an ISP [Internet service provider] connects its end-users, but also by how well different intermediary networks and ISPs interconnect and exchange traffic.'

Moving ahead

'This study highlights the importance of the still vastly underappreciated IXP ecosystem,' said Professor Steve Uhlig, senior supervisor of the team and Principal Investigator of the Horizon 2020-funded project. 'Indeed, IXPs are vital to supporting high-speed connectivity in the Internet, especially for large content delivery players such as Netflix. This study supports the need to carry out more research relevant for IXPs, as done within the ENDEAVOUR project.'

For the ENDEAVOUR team, a better understanding of IXPs is key to reaching the project's core objective: enabling added-value services to be provided thanks to 'Software-defined networking' (SDN), on top of Internet Exchange Points and other network interconnection fabrics. They have until December 2017 to do so, when the project is due to finish.

The project's study of Netflix, titled 'Open Connect Everywhere: A Glimpse at the Internet Ecosystem through the Lens of the Netflix CDN,' is available on the ArXiv website.

ENDEAVOUR

- Coordinated by Queen Mary University of London in the United Kingdom.
- Funded under H2020-ICT.
- http://cordis.europa.eu/news/rcn/126104
- Project website: https://www.h2020-endeavour.eu/
- http://bit.ly/2dM7bul

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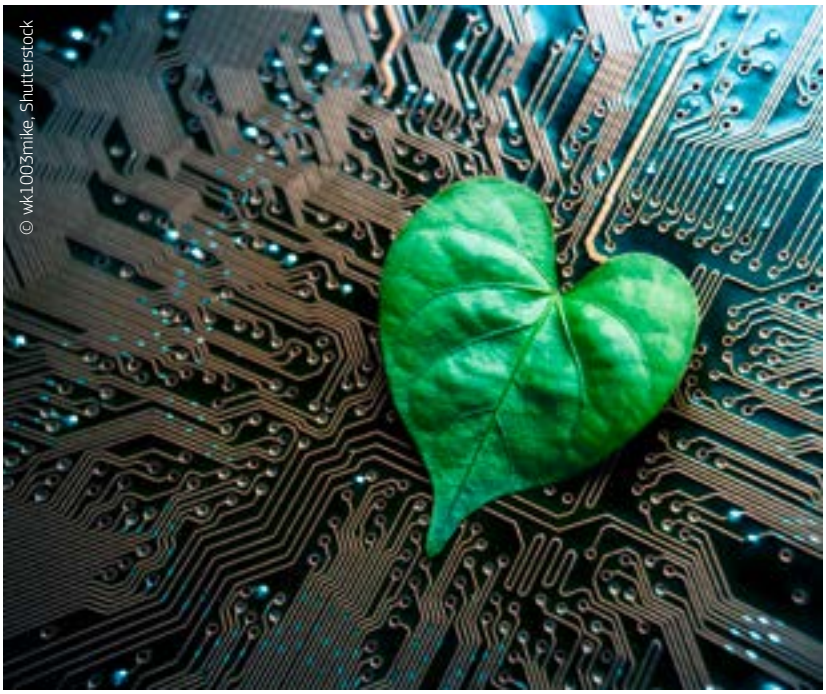
ENERGY-EFFICIENT SOLUTIONS FOR HIGH PERFORMANCE COMPUTING

EU-funded researchers have unveiled a set of tools that will make computer systems more energy efficient, providing large data streaming aggregations 54 times more efficient than standard implementations.

With the relentless growth of the digital economy and society's increasing use of data, energy consumption and mitigation of serious environmental impacts have become key challenges of modern computing, whether for wireless embedded client devices or 'High performance computing' (HPC).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Plugging the gap

The three-year EXCESS (Execution Models for Energy-Efficient Computing Systems) project, which will finish at the end of August 2016, took on this challenge and addressed what the project partners saw as a lack of holistic, integrated approaches to cover all system layers, from hardware to user-level software, and the limitations this caused to the exploitation of existing solutions and their energy efficiency. At the outset of the project, the team analysed where energy-performance is wasted, and armed with this knowledge, they developed a framework that should allow for rapid development of energy efficient software production.

'When we started this research programme, there was a clear lack of tools and mathematical models to help the software engineers to program in an energy efficient way, and also to reason abstractly about the power and energy behaviour of their software,' commented Philippas Tsigas, Professor in Computer Engineering at Chalmers University of Technology, and EXCESS project coordinator. 'The holistic approach of the project involves both hardware and software components together, enabling the programmer to make power-aware architectural decisions early. This allows for larger energy savings than previous approaches, where software power optimisation was often applied as a secondary step, after the initial application was written.'

The project has taken major steps towards providing a set of tools and models to software developers and system designers to allow them to program in an energy-efficient way. The tool box spans from fundamentally new energy-saving hardware components, such as the Movidius Myriad platform, to sophisticated efficient libraries and algorithms.

Tests run on large data streaming aggregations, a common operation used in real-time data analytics, has shown impressive results. When using the EXCESS framework, the programmer can provide a 54 times more energy-efficient solution compared to a standard implementation on a high-end PC processor. The holistic EXCESS approach first presents the hardware benefits, using an embedded processor, and then continues to show the best way to split the computations inside the processor, to enhance the performance even further.

Energy-efficient embedding for HPC

Movidius, an EXCESS project partner, and developers of the Myriad platform of vision processors, has integrated both the technology and methodology developed in the project into their standard development kit hardware and software offering. In the embedded processor business, there has been a gradual migration of HPC class features getting deployed on embedded platforms.

The rapid development in autonomous vehicles such as cars and drones, driving assist systems, and also the general development of home assist robotics (for example vacuum cleaners and lawnmowers) has led to the porting of various computer vision algorithms to embedded platforms. Traditionally these algorithms were developed on high performance desktop computers and HPC systems, making them difficult to redeploy to embedded systems.

Another problem was that the algorithms were not developed with energy efficiency in mind. However, the EXCESS project has enabled and directed the development of tools and software development methods to aid the porting of HPC applications to the embedded environment in an energy efficient way.

EXCESS

- Coordinated by Chalmers University of Technology in Sweden.
- Funded under FP7-ICT.
- http://cordis.europa.eu/news/rcn/126105
- Project website: http://excess-project.eu/

NEW TECHNOLOGIES FOR IMPROVED PARALLEL COMPUTING

The REPARA project has developed and registered new technologies that are expected to make parallel computing applications more energy efficient, less expensive, and easier to develop and maintain.

The continuous quest for more power has seen our computers evolve from machines with a single processing component to complex architectures combining the likes of CPUs with multiple cores, GPUs and DSPs. However, it is common knowledge that these technologies have much room for improvement when it comes to performance and energy consumption.

The REPARA (Reengineering and Enabling Performance And poweR of Applications) project, which ends this month, has been focused on this objective since 2013. Grouping experts in software engineering, development tools and computer hardware, it originally aimed to achieve a unified programming model for heterogeneous computers, that is, a transformation of existing source code so that it can be run with multiple graphic cards and reconfigurable hardware. They have recently published some of their advances in the International Journal of Parallel Programming.

'We've made significant improvements in both performance and energy efficiency, comparable to those that can be made with a manual development process,' said the project's coordinator José Daniel García, an associate professor in UC3M's Computer Science department. 'The difference is that with a manual development process, we need months of engineering, while with our semiautomatic process we can do the same tasks in a few days.'

Thanks to EU funding to the tune of EUR 2.6 million, the team has developed and registered various technological products that they may commercialise with an interested European company.

Their work consisted, amongst other things, in source code 'refactoring', a technique used in software engineering to improve the internal structure of a programme without altering its observable behaviour. Three fundamental properties of the original source code were improved: performance (helping increase the speed of execution), energy efficiency (reducing energy consumption) and maintainability.

'These software products can help developers to offer engineering services to third parties by simplifying the development process. We can also reduce the time that the engineers need to fine-tune a software product in a parallel heterogeneous environment, which will significantly reduce development costs and increase software development industry competitiveness,' said Prof. García. A large panel of markets, including health, transportation, robotics and industry — for the analysis of defects in manufactured parts — are set to benefit from this innovation, and use cases have already been used for each of these sectors.

Cevelop — an integrated development environment for C/C++ developers — and Fastflow — a C++ parallel programming framework advocating high-level, pattern-based parallel programming — are two notable development tools created by the seven-strong consortium. These tools are available for download on their respective websites.

REPARA

★ Coordinated by UC3M in Spain.
★ Funded under FP7-ICT.
★ http://cordis.europa.eu/news/rcn/126001
★ Project website: http://repara-project.eu/

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INDUSTRIAL TECHNOLOGIES

ULTRA-LONG LASERS CHALLENGE CONVENTIONAL KNOWLEDGE ABOUT LASER TECHNOLOGY

The EU-funded ULTRALASER project is proving that lasers can be more than just sources of coherent light. With the right configuration, they can also serve as a transmission medium — a development that opens the door to an array of new uses.

Thanks in part to advances in material science, technology and underlying physics, today lasers have become ubiquitous devices used across a range of sectors — including fundamental science, manufacturing, engineering, telecommunications and medicine. Continuing along this trajectory of advancement in laser technology, the ULTRALASER (Ultralong fibre lasers) project is focusing on the development of ultra-long lasers, or lasers with a cavity formed by a long (up to hundreds of kilometres) span of optical fibre transformed into an amplifying medium by the Raman effect.

Ultra-long lasers are challenging the conventional view of lasers as being just sources of coherent light. According to ULTRALASER researchers, when an ultra-long laser cavity implemented in optical fibre is used, the laser can function not only as a source of coherent light, but also as a transmission medium.

'Such an ultra-long resonator, which can have a length scale of several hundred kilometres, is not only an exciting new physical system, but could lead to a radical new outlook on the transmission of information and secure communications,' says the project's Principal Investigator Sergei Turitsyn. He notes that such lasers with extended resonators and the closely related distributed feedback random fibre laser systems will likely have applications in such fields as telecommunications, spectroscopy, global positioning systems, material processing and bio-medical imaging.

A new enabling technology

ULTRALASER developed a new architecture comprised of random distributed feedback lasers capable of exploiting multiple Rayleigh scattering (the scattering of light on inhomogeneities in an optical fibre medium). This process, combined with distributed Raman amplification, was used to produce feedback and lasing in long fibre.

'We believe the amplification technique based on ultra-long fibre lasers could be a new enabling technology for transmission with very long amplification spans,' notes Turitsyn. 'Even more exciting, this "quasi-lossless" fibre medium will likely have interesting applications in all-optical nonlinear data processing.' According to Turitsyn, this advancement will open up methods for the design of photonic devices based on a mathematical theory of integrable nonlinear systems, with functionalities that cannot be achieved in linear optical devices. 'This research is directly relevant to increasing capacity of optical communication systems,' he says.

In addition, the project has explored new architectures of model-locked lasers, including isolator-free cavities and various gain fibres to support generation in the 1-2 micron wavelength range. Project researchers also discovered a new mechanism of spontaneous pattern formation in fibre lasers that results from the periodic zig-zag modulation of losses for different spectral components.

According to Turitsyn, this discovery is important for creating a new generation of efficient pulsed fibre lasers that are used in various applications. 'Our research has led to the development of new measurements and signal processing techniques for characterising partially mode-locked and stochastic generation and uncovering the complex intra-cavity dynamics of radiation with localised structures,' he says. 'The project has advanced the science and technology of lasers featuring extended cavity length.'

Advancing physics and opening doors

Clearly, the ULTRALASER project has made significant contributions to the understanding of the underlying physics of ultra-long fibre lasers and the non-linear physics behind conventional fibre lasers. 'We have developed new engineering technologies and explored emerging research and technology applications,' explains Turitsyn. 'Overall, the project advanced the physics underlying the operation of fibre lasers and has revealed new opportunities and directions in high-speed fibre communications, secure communications and laser physics — among other scientific and technology-related fields.'

But the work doesn't stop here. As a result of these initial breakthroughs, Turitsyn was awarded a follow-up proof-of-principle grant for the commercialisation and knowledge transfer of the project's key technology and architecture. So stay tuned for a demonstration of a commercial prototype featuring advanced parameters in the near future.

ULTRALASER
★ Coordinated by Aston University in the United Kingdom.
★ Funded under FP7-IDEAS-ERC.
★ http://cordis.europa.eu/news/rcn/125880

SELECTIVE LASER MELTING FOR ALUMINIUM ALLOYS

New aircraft designs are driving manufacturers to use new processes that result in significant weight savings. At the same time, shape complexity is increasing. Selective laser melting is a potential candidate for addressing these challenges, but it is not widely employed because of its lack of maturity.

Selective laser melting is a process for fabricating complex parts from loose powder and has the potential to achieve significant savings in materials, energy and time. Today, the process is commonly used in engineering titanium alloys, stainless steels and nickel-based alloys.

The EU-funded project HI-STA-PART (High strength aluminium alloy parts by selective laser melting) aimed to demonstrate its suitability for producing aerospace-grade aluminium alloy parts. Selective laser melting of aluminium alloys is not as straightforward as with other materials because of the combination of their physical properties.

Aluminium is characterised by low absorption of infrared radiation and high thermal conductivity whose combination results in relatively porous parts. To address this problem, engineers rely on high laser power and multiple scans per layer to remedy defects.

The HI-STA-PART team focused on a new alloy called Scalmalloy® characterised by its high-strength capabilities and weldability. This second-generation aluminium-magnesium-scandium alloy had been developed outside of the project to produce aircraft aluminium parts.

Researchers analysed the powder size distribution of Scalmalloy® and found that it matches the requirements for selective laser melting. Moreover, its tapped density was estimated to be around 51-52 %, which is very similar to other types of powder used so far.

In addition, the flowability of the powder was tested in different selective laser melting systems. The results confirmed that it can be processed by laser and, therefore, used it to produce demonstration components. One of them was the locking hub of a door-opening mechanism, while another was a corner fitting for aircraft.

Once the demonstration components had been manufactured, researchers examined possible deviations from the computer-aided design model; these did not exceed ± 0.250 mm. The relatively small figure suggested that a final machining stage is necessary to ensure optimal performance of the parts.

The samples produced during HI-STA-PART were also tested in terms of fatigue and hardness. Despite the localised corrosion observed on the surface and its relative softness compared to other aluminium alloys, Scalmalloy® proved to be a suitable material for aircraft components.

Importantly, selective laser melting of Scalmalloy® promises less waste than traditional manufacturing processes, such as milling, turning and grinding. Besides a smaller environmental footprint, HI-STA-PART has demonstrated the many benefits of this direct manufacturing process that can help the European aircraft manufacturing industry maintain its competitive advantage.

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HI-STA-PART
★ Coordinated by TWI in the United Kingdom.
★ Funded under FP7-JTI.
★ http://cordis.europa.eu/result/rcn/188389

INNOVATIVE FOOD PACKAGING EXTENDS SHELF LIFE, REDUCES FOOTPRINT

Completed in April 2016, the BIO4MAP project is now bringing a new type of sustainable food packaging to the market. The consortium promises a significant increase in shelf life for fresh pasta and cheese, a cost 25% lower than alternatives, and an environmental and carbon footprint reduced by up to 29%.

The newly developed packaging material consists of at least 75% raw materials from renewable sources. It includes different layers of bioplastics — PLA, PVOH and adhesives — and a wax coating produced from olive leaves. It is easy to recycle, presents excellent mechanical properties, is biodegradable and protects its content from oxygen and humidity, thereby preventing the development of bacteria and fungi.

The project, which had a budget of EUR 1.5 million, was coordinated by AIMPLAS — a research technology centre located in Spain with 25 years of experience in plastics research and development. 'The role of AIMPLAS in this project, besides coordinating it, has been focused on developing the biodegradable and oxygen-barrier material needed to comply with the final requirements of the food to be packaged, as well as being responsible for processing the new materials developed to obtain the new multilayer packaging,' Nuria López, main Researcher at AIMPLAS, explained.

Brought together, the materials contained in the BIO4MAP (Transparent and high barrier biodegradable film and sheet for customized Modified Atmosphere food Packaging) packaging have a carbon footprint that is 57% lower than that of materials traditionally use to pack cheese and fresh pasta. PLA boasts excellent mechanical properties and ease of recycling, whilst PVOH is a good gas barrier with water solubility: it disappears in the washing process, allowing PLA to be properly isolated and recycled. A wax coating processed by project partner Fraunhofer covers the external layer of the packaging, providing a water vapour barrier and improving the flexibility of PLA.

All these materials are joined by a new generation of biodegradable adhesives, which is one of the main innovations brought by BIO4MAP. While these materials were already commercially available, their processing as a coextrudate into a multilayer laminate had yet to be achieved.


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Altoni Pasta and Sachsenmilch are already counting on BIO4MAP's solution to pack their products, whilst the intersupplier of Mercadona, Central Quesera Montesinos, is contemplating it for the new packages of its cheesecake. All fresh food that requires a modified atmosphere packaging to be conserved is set to benefit from the use of this new packaging.

Besides the above-mentioned partners, BIO4MAP also saw participation from Vallés Plàstic, which was responsible for applying the new coating, and Artibal, a manufacturer of waxes, lacquers and inks responsible of its formulation. The compounding company MAPEA has developed the biodegradable adhesive together with Finnish research centre Abo Akademi, and packaging transforming and manufacturing was handled by Bobino Plastique in France.

BIO4MAP

- Coordinated by Aimplas in Spain.
- Funded under FP7-SME.
- http://cordis.europa.eu/news/rcn/126003
- Project website: http://www.bio4map.eu/
- http://bit.ly/2deP4JD

INTRODUCING THE WORLD'S BIGGEST NANOMATERIAL PRODUCTION PLANT

The SHYMAN project aims to establish continuous hydrothermal synthesis as the most flexible and sustainable process for creating nanomaterials at industrial scale. After demonstrating this potential in the lab, the project has now announced the opening of its first facility in Nottingham.

'This new facility opens up a significant amount of new opportunities for us,' says Professor Ed Lester, Technical Coordinator of Promethean Particles. This spin-out of the University of Nottingham is in charge of operating the new plant, which is expected to produce over 1 000 tonnes of nanomaterials every year. The production cost is lower than that of other facilities and the chosen production method — continuous hydrothermal synthesis — is expected to even impact markets for which sale prices have so far been an obstacle.

'We have already had a lot of interest from companies in a diverse range of sectors. From healthcare, where nanoparticles can be used in coatings on medical devices, to enhanced fabrics, where nano-materials can add strength and flexibility to textiles, and printed electronics, as we are able to print materials such as copper,' Prof. Lester continues. Solvay, Fiat, PPG and Repsol are among the major companies already set to benefit from the plant's products.

To reach these impressive levels of production, the plant notably relies on

high pressure triplex plunger pumps manufactured by Cat Pumps. These pumps have helped the 18-strong consortium to overcome engineering issues related to the mixing of the heated fluid and the aqueous metal salt flow, by creating the continuous pressure and fluid flow necessary to achieve continuous production.

Another enabling technology is the Nozzle Reactor, a customised design that uses buoyancy-induced eddies to produce an 'ideal' mixing scenario in a pipe-in-pipe concentric configuration in which the internal pipe has an open-ended nozzle. This technology allows Promethean Particles to dramatically improve reproducibility and reliability whilst controlling particles' properties such as size, composition and shape.

Betting on hydrothermal synthesis

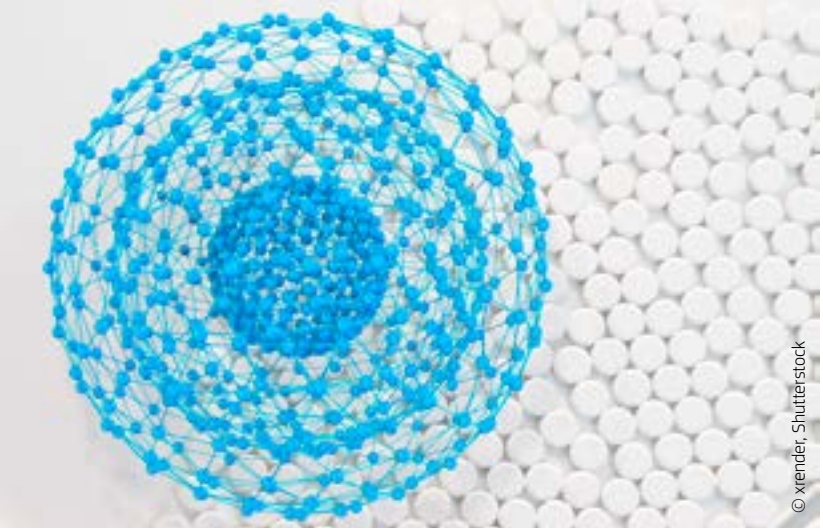
Started in 2012, SHYMAN (Sustainable Hydrothermal Manufacturing of Nanomaterials) built upon the observation that hydrothermal synthesis had numerous advantages compared to alternatives: it doesn't resort to noxious chemicals, uses relatively simple chemistry relying on cheap precursors, allows straightforward downstream processing, can avoid agglomeration and allows for narrow and well-controlled size and shape distribution.

The optimisation of hydrothermal synthesis has been a key objective of the University of Nottingham for the past 14 years, and SHYMAN is the pinnacle: the project began with the development of bench scale reactors, followed by a 30-times-larger pilot scale reactor. The reactor at the heart of the new production plant is 80 times larger than the latter and features four Cat Pumps Model 3801 high pressure triplex plunger pumps.

'These are very exciting times for Promethean Particles,' said Dr Susan Huxtable, Director of Intellectual Property and Commercialisation at the University of Nottingham. 'The new facility opens up a myriad of opportunities for them to sell their services into new markets right across the world. It is a great example of how many of the technologies developed by academics here at the University of Nottingham have the potential to benefit both industry and society.'

SHYMAN

- Coordinated by the University of Nottingham in the United Kingdom.
- Funded under FP7-NMP.
- http://cordis.europa.eu/news/rcn/125901
- http://bit.ly/29SDW8j



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A RETURN TO CLEAN, GREEN BUILDING MATERIALS

Replacing lime mortar with cement for the repair and maintenance of historic buildings during the past two centuries has led to irreversible damage. An EU initiative set out to design new, sustainable and environment-friendly lime-based mortars.

Restorers and manufacturers now appreciate the need to use lime in the design of sustainable, compatible and durable repair mortars. In recent years, industrial mortar production has led to ready-to-use mortar that lacks the quality of its traditionally prepared alternative. There is a clear requirement to use sustainable building materials and to implement methods that lead to less pollution, carbon emissions and energy consumption.

To address this issue, the EU-funded NATURALIME (Naturally durable: Developing and testing the resilience of innovative natural admixtures for lime-based conservation mortars) project set out to design lime mortar to be used as repair material for historic buildings.

Project partners examined and used natural admixtures composed of lime and vegetable and animal derivatives to modify certain characteristics of mortar. To this effect, they investigated dry hydrated lime, natural hydraulic lime and lime putty.

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The NATURALIME team studied mortar prepared with the hemp plant and its shiv (inner woody part of the stem). Results reveal that mixes of hemp shiv with natural hydraulic lime perform better than those made with aerial limes in the form of dry hydrated powder or putty. Hemp-lime mixes also appear to be durable in Mediterranean, semi-arid and tropical climates.

Researchers also studied mixes made with lime and organic additives, particularly natural polysaccharides from seaweed. They found that adding these polysaccharides to the lime paste increases the plasticity of the fresh mix in a manner that depends on the mixing process, time and temperature.

Overall, findings show that natural hydraulic lime is best used with hemp shiv.

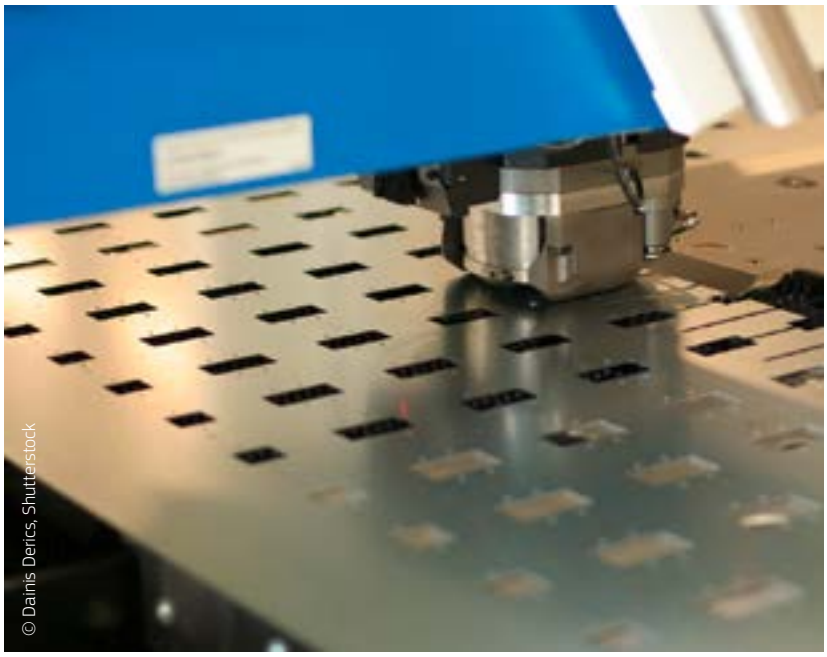
NATURALIME successfully demonstrated the consequences of natural and sustainable admixtures on repair mortars. Through this project, the monument and historical heritage of Europe should benefit for years to come.

NATURALIME

★ Coordinated by the University of Oxford in the United Kingdom.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/183222

SUPERIOR 3D MICROFORMING

An EU team has developed a new microforming process for making stamped-metal parts. The innovation involves new tool materials and coatings, new technologies for manufacture and a model that drives the process.



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Metal forming, essentially a form of sheet-metal stamping, is a generally efficient way of manufacturing large parts. However, for 3D microparts, the process requires many additional and wasteful steps, which must be eliminated if Europe is to maintain its competitiveness.

The EU-funded HIPR (High-precision micro-forming of complex 3D parts) project demonstrated the feasibility of an efficient new microforming process. The new method was shown to achieve the highest quality standards, while lowering costs and environmental impact, yet increasing productivity.

Work focused on three main areas. To increase tool lifetime, the team examined tool materials, including hard metals and ceramics. Researchers also examined new coatings and surface modification techniques. At the same time, the group reconsidered toolmaking strategies, so as to enable the necessary micro-features. The study investigated technologies such as ultra-precision grinding and laser ablation, which were shown to achieve the desired results.

New methods included in-line measurement of 3D shapes and material properties. Measurements also covered tool force and temperature, which helped determine when to stop production because a tool had reached the end of its life. The outcome was 100% quality control.

Process modelling, to predict the process, involved implementation of a tool wear and fracture model able to be integrated into conventional 'Finite element method' (FEM) modelling software. To do so, the team modelled selected tool materials, examined implementation in terms of FEM code and predicted selected microforming processes.

Exploitable results include a 15-tonne press micro-manufacturing pilot line, a sensorised stamping tool, an in-line measurement system and a tool lifetime prediction model. For each, the group devised a marketing plan, including risks and contingencies.

The HIPR project's new tools and tool management systems increase productivity and achieve a higher overall quality. Alongside this, the outcomes provide an added boost to European industrial capability and competitiveness.

HIPR

★ Coordinated by D'Appolonia in Italy.
★ Funded under FP7-NMP.
★ http://cordis.europa.eu/result/rcn/183218

"Exploitable results include a 15-tonne press micro-manufacturing pilot line, a sensorised stamping tool, an in-line measurement system and a tool lifetime prediction model."

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SECURITY & SAFETY

EU RESEARCHERS DISCOVER THAT MAGMA BUILD-UP MAY PUT SALVADORAN CAPITAL AT RISK

Researchers from the EU-funded VUELCO project have found that the build-up of magma 6 kilometres below El Salvador's Ilopango caldera means that the country's capital, San Salvador, may be at risk from future volcanic eruptions.

The team, comprised of VUELCO (Volcanic unrest in Europe and Latin America: Phenomenology, eruption precursors, hazard forecast, and risk mitigation) researchers from the University of Bristol, UK, and El Salvador's Ministry of the Environment and Natural Resources, studied the density distribution beneath the Ilopango caldera and how tectonic stresses — caused by movement of tectonic plates along fault lines — have an impact on the build-up of magma at depth. The findings have been published in the most recent issue of the journal 'Nature Communications'.

A caldera is a large cauldron-like volcanic depression or crater, formed by the collapse of an emptied magma chamber. The depression often originates from very big explosive eruptions. In Guatemala and El Salvador, caldera volcanoes straddle tectonic fault zones along the Central American Volcanic Arc (CAVA). The CAVA is 1 500 km long, stretching from Guatemala to Panama.

Specifically, the Ilopango caldera is an 8 x 11 km volcanic collapse structure of the El Salvador Fault Zone. The collapsed caldera was the result of at least five large eruptions over the past 80 000 years. The last of these eruptions occurred around 1 500 years ago and produced enough volcanic ash to form a 15 cm thick layer across an area the size of the UK. The eruption was so powerful that it would have destroyed almost everything within a 100 km radius, including a well-developed Mayan population. It also significantly disturbed Mayan populations as far as 200 km away. The most recent eruptions were in 1879-1880 but were on a much smaller scale.

"Our results indicate that localised extension along the fault zone controls the accumulation, ascent and eruption of magma at Ilopango."

'Most earthquakes take place along the edges of tectonic plates, where many volcanoes are also located,' commented VUELCO project coordinator and co-author of the study, Dr Joachim Gottsmann. There is therefore a link between the breaking of rocks, which causes faults and earthquakes, and the movement of magma from depth to the surface, in feeding a volcanic eruption. The link between large tectonic fault zones and volcanism is, however, not very well understood.

Previous studies have shown that magma accumulation before a large caldera-forming eruption, as well as the caldera collapse itself, may be controlled by fault structures. However, the research team states that it's unclear to what extent regional tectonic stresses influence magma accumulation between large caldera-forming eruptions.

The team discovered that the current tectonic stress field promotes the accumulation of magma and hydrothermal fluids at shallow (less than 6 km) depth beneath Ilopango. The magma contains a considerable amount of gas, which indicates the system is charged to possibly feed the next eruption.

'Our results indicate that localised extension along the fault zone controls the accumulation, ascent and eruption of magma at Ilopango,' said Dr Gottsmann. 'This fault-controlled magma accumulation and movement limits potential vent locations for future eruptions at the caldera in its central, western and northern part — an area that now forms part of the metropolitan area of San Salvador, which is home to 2 million people. As a consequence, there is a significant level of risk to San Salvador from future eruptions of Ilopango.'

Although these findings have only just been published, the VUELCO project officially ended in September 2015 and received just under EUR 3 500 000 in EU funding. The project, a collaborative effort between European and Latin American researchers, devised global strategies for enhancing volcanic monitoring capacity, better data interpretation and the identification of reliable eruption precursors.

VUELCO

- Coordinated by the University of Bristol in the United Kingdom.
- Funded under FP7-ENVIRONMENT.
- http://cordis.europa.eu/news/rcn/125961
- Project website: http://www.vuelco.net/
- http://bit.ly/2d9Fc8Q

BETTER INTEROPERABILITY TO MANAGE MAJOR CRISES

During major disasters, local response teams usually require the support of units from around the world. An EU initiative has designed solutions that take into account the special needs of multinational cooperation in emergency situations.

The majority of emergency units function according to their own management support and disaster response service procedures. When regional and international teams are deployed to a disaster site, breakdowns in communication and operations can occur.

"All solutions developed were assessed on their potential to improve the effectiveness and efficiency of managing large-scale crises."


© Dr Ralf Hedel

Thanks to EU funding, the IDIRA (Interoperability of data and procedures in large-scale multinational disaster response actions) project created a set of tools, interfaces and procedures to improve the process of coordinating and sharing information between the field operations.

Project partners developed a system to help coordinate disaster response efforts between several organisations involved. They implemented and assessed methods to enhance the interoperability between organisations. The system supports information exchange between various sources such as sensors, legacy command and control systems, public data sources and simulation tools. In addition, it helps to overcome language barriers.

The IDIRA team also developed new tools for effective response management that provide situational awareness and assist with incident and task management. In addition, these tools trace missing persons and evaluate urgent needs.

All solutions developed were assessed on their potential to improve the effectiveness and efficiency of managing large-scale crises. Following small-scale trials and training, the system was deployed and successfully demonstrated in three field exercises involving pandemic, flood, earthquake and fire scenarios.

By developing novel technologies and procedures that will enhance communication, information and decision support during disaster response actions, IDIRA should prevent further loss of life and help to stabilise the affected population sooner.

IDIRA

- Coordinated by Fraunhofer in Germany.
- Funded under FP7-SECURITY.
- http://cordis.europa.eu/result/rcn/159605
- Project website: http://www.idira.eu/
- http://bit.ly/2e0jeo6

EU RESEARCH FINDS EXISTING NAVIGATIONAL DATA CAN HELP PILOTS AVOID TURBULENCE AND IMPROVE AIR TRAVEL SAFETY

Research aided by the DELICAT project has highlighted how turbulence can be detected in a much faster and more efficient way, using data already routinely broadcast by commercial airlines.

Detecting turbulence remains a key challenge of modern-day aviation, with reports submitted by pilots often being very inaccurate. However, due to being the least expensive method, it is the most frequently used for trying to predict where it will occur.

A team from the Faculty of Physics, University of Warsaw, have shown that there is every indication that data allowing pilots to avoid turbulence and even to forecast such occurrences are already being routinely recorded, and have been recorded for many years. Jacek Kopec, a doctoral student at the Faculty of Physics, has managed to extract this valuable information from the flight parameters routinely broadcast by the transponders installed in most modern commercial aircraft. What is most promising is that this new method for detecting turbulence is not only original but also potentially very easy to implement.

"The research team plans to improve upon this software but have already shown how this new method for detecting turbulence really works."

'Today's commercial aircraft fly at altitudes of 10 to 15 km, where the temperatures fall to -60 °C. Conditions for measuring atmospheric parameters are very difficult, which explains why such measurements are not taken systematically or extensively,' commented Kopec. 'A lack of sufficiently accurate and up-to-date information not only exposes aircraft and their passengers to danger, it also restricts the development of theories and tools for forecasting turbulence.'

Overcoming cost hurdles

Presently, 'pilot reports' (PIREPs) are relayed by radio and provided to pilots of other aircraft by air traffic controllers, and are a basic source of turbulence data. As these reports are based on the subjective opinions of pilots, the data collected in this fashion are often marred by substantial inaccuracies concerning both the area of turbulence and its intensity. More accurate readings are provided by aircraft involved in the Aircraft Meteorological Data Relay (AMDAR) programme. This method is nonetheless costly, so data collected at cruising altitudes are transmitted relatively rarely. In practice, this prevents such reports from being used to detect and forecast turbulence.

Passenger aircraft are fitted with sensors that record a variety of flight parameters. Unfortunately, most of the data is not made publicly available. Publicly available reports include only the most basic parameters such as the position of the aircraft (ADS-B transmissions, which are also used by the popular website FlightRadar24) or its speed relative to the ground and the air (Mode-S data). Meanwhile, detecting turbulence requires knowledge of the vertical acceleration of aircraft. 'Vertical accelerations are especially strongly felt both by the passengers and by the aircraft,' Kopec explained. 'Unfortunately, there is no access to materials regarding vertical accelerations. That was why we decided to check if we could extract such data from other flight parameters, accessible in Mode-S and ADS-B transmissions.'

The research team tested three algorithms of turbulence detection. The first relied on information about the position of aircraft (ADS-B transmissions). However, preliminary tests and their comparison against the parameters registered in the same area by the research aircraft failed to produce satisfactory results. As for the remaining two algorithms, each of them used, though in somewhat different ways, the parameters received approximately every four seconds through Mode-S transmissions. In the second approach, the parameters were analysed using the standard theory of turbulence. In the third approach, the scientists adapted a method for determining turbulence intensity previously used to measure turbulence on a very small scale in the understory of forests.

Once wind velocity in the vicinity of the aircraft was determined and its changes were analysed in successive readings, it was possible to use the latter two theoretical approaches to locate turbulence areas with an error of only 20 km.

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Passenger aircraft need around 100 seconds to travel this distance, so this level of accuracy would allow pilots to manoeuvre their aircraft to effectively avoid turbulence.

An easy system to implement

By harnessing the existing data, this system of turbulence detection therefore requires no significant investments in aviation infrastructure. To be operational, it just requires adequate software and a computer connected in a simple way to the devices that receive Mode-S transmissions from the transponders onboard aircraft, which are standard equipment. In essence, passenger aircraft act as sensors by creating a dense network of measurement points above Europe.

Over the coming months, the research team plans to improve upon this software but have already shown how this new method for detecting turbulence really works. The data for the research was collected in a flight test campaign that formed part of the DELICAT (DEmonstration of LIdar based Clear Air Turbulence detection) project, which finished in March 2014. The results detailing the new system were published in the May 2016 issue of 'Atmospheric Measurement Techniques' with further details released by the University of Warsaw in August 2016.

DELICAT

- Coordinated by Thales Avionics in France.
- Funded under FP7-TRANSPORT.
- http://cordis.europa.eu/news/rcn/126044
- Project website: http://delicat.inoe.ro/

MULTIMEDIA TO BECOME MORE SECURE

The barrage of multimedia files being created and distributed often suffers from security violations, authenticity validation and searchability challenges. A new suite of high-tech tools promises to be a game changer in this respect.

More and more multimedia files are being generated and shared every day, giving rise to many challenges in managing these files, particularly when it comes to efficiently searching and verifying contents. Keeping in mind that multimedia files can be easily altered, currently available security solutions are not adequately effective in verifying integrity and authenticity.

The EU-funded MAVEN (Management and authenticity verification of multimedia contents) project worked on developing new tools for multimedia data management and security. It proposed a 'search and verify' approach that automatically searches digital contents for objects of interest using advanced audiovisual pattern recognition tools, and applies forensic analysis to ascertain authenticity and integrity.

To achieve its aims, the project team developed a comprehensive software framework with both forensic tools and search tools. The forensic tools were designed to conduct effective verification of image source, image integrity and video integrity. The search tools, on the other hand, were aimed at text localisation/recognition, spoken keyword detection, face detection/recognition, and object/scene recognition.

All the tools were validated during the project, which also developed a demonstrator application that showcases the MAVEN suite's features, including its integrability and modularity. The security component of the suite can be very useful for law enforcement authorities and for investigating legal issues. In parallel, the media component shows much promise for advancing automatic searches and classification related to information retrieval.

The consortium of small and medium-sized enterprises working on the project also stand to gain significantly from the project's research, as they look set to become more competitive in their field and their markets. Overall, numerous small and medium-sized businesses, as well as law enforcement agencies, insurance companies and media businesses such as television broadcasters are slated to benefit from this technology. The future of multimedia in Europe is finally looking safer and more secure.


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MAVEN

- Coordinated by Gradiant in Spain.
- Funded under FP7-SME.
- http://cordis.europa.eu/result/rcn/188622
- Project website: http://maven-project.eu/

"Before Herschel we only knew of a few hundred such dusty sources in the distant universe and we could only effectively 'see' them in black and white."

SPACE

A CLEANER UNIVERSE AS NEWLY BORN STARS ABSORB COSMIC DUST

A team of EU-funded researchers have discovered that the universe is becoming cleaner as cosmic dust is mopped up by the formation of new stars.

Researchers at the University of Cardiff, UK, part funded by the European Research Council (ERC) under the COSMICDUST (Lighting up the dark — the evolution of dust throughout cosmic time) project, have used the Herschel space telescope to peer back 12 billion years to observe the very early formation of galaxies and compare them to galaxies that have formed much more recently.

The results showed them that stars were forming inside galaxies much faster in the past compared to today, and that this rapid star birth is using up more and more of the cosmic dust that is spread throughout the universe. Cosmic dust is comprised of tiny solid particles that are found everywhere in space between the stars, and along with gas, are the raw materials from which stars and galaxies form. The research has shown that even only 1 billion years in the past, a small fraction of the age of the universe, galaxies were forming stars faster and contained more cosmic dust than galaxies today.

Although this blanket of material is crucial for the formation of stars and galaxies, it also acts as a sponge, absorbing almost half of the light emitted by stellar objects and making them impossible to observe using standard optical telescopes.

Launched in 2009, the Herschel space telescope provides astronomers with the perfect tool for probing the hidden universe. Possessing a collection of sensitive instruments, mirrors and filters, the telescope was able to detect the dust through the far-infrared emission it emits, revealing the existence of stars and galaxies hidden by the dust.

Professor Haley Gomez, one of the project leads, presented the team's results on 29 June at the British National Astronomy Meeting in Nottingham, UK. The research team has now released a large catalogue of the sources of far-infrared radiation in this 'hidden universe'. The team's survey of the sky, called the Herschel Astrophysical Terahertz Large Area Survey (Herschel ATLAS) has revealed the details of over half a million galaxies, many of which have been as they were over 12 billion years ago, only shortly after the Big Bang. Moving forward, the team hope that this extensive catalogue will become a vital tool for astronomers hoping to understand the detailed history of galaxies and the wider cosmos.

Published in the journal 'Monthly Notices of the Royal Astronomical Society', Dr Elisabetta Valiante, one of the lead authors, commented: 'The exciting thing about our survey is that it encompasses almost all of cosmic history, from the violent star-forming systems full of dust and gas in the early universe, that are essentially galaxies in the process of formation, to the much more subdued systems we see around us today.'

Dr Loretta Dunne, another prominent member of the research team also commented: 'Before Herschel we only knew of a few hundred such dusty sources in the distant universe and we could only effectively "see" them in black and white. Herschel, with its five filters, has given us the equivalent of technicolour, and the colour of the galaxy tells us about their distances and temperatures. So we now have half a million galaxies we can use to map out the hidden star formation in the universe.'

The COSMICDUST project will continue until August 2020 and has received around EUR 1 800 000 in EU funding.

COSMICDUST

- ★ Coordinated by Cardiff University in the United Kingdom.
- ★ Funded under ERC-COG.
- ★ http://cordis.europa.eu/news/rcn/125699

ENLIGHTENING SUPERNOVAE

Plenty of diversity is seen among supernovae. EU-funded researchers worked to understand this process as these events are of critical value in cosmology.

Supernovae occur mainly in two ways — the core collapse of massive stars, and the overloading of old white dwarfs with captured material. Supernovae produced when white dwarf stars accumulate excess mass that triggers a runaway thermonuclear reaction in the star are called Type Ia supernovae. These events can be used as 'standard candles' to estimate distances to the relevant galaxy based on their apparent brightness.

"The supernova properties were also found to be sensitive to the properties of the galactic locations within which they exploded."


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The LDSNPS (Linking the diversity of Type Ia supernovae to their progenitor systems) project undertook a research programme to improve our understanding of how the stars explode, and how accurately they can be used to measure distances. By comparing new observations with predictions from the theory of the explosion mechanism, they aimed to answer two questions: is there more than one way to make an SN Ia, and does their observed diversity depend on their progenitor systems and host galaxy environments?

Data from leading ground-based transient surveys provided properties (expansion velocities, presence of elements, and luminosities) of the supernovae to compare with theoretical explosion models. Some complete-burning explosion models were eliminated based on the presence of high-velocity unburned elements observed in the supernova. The supernova properties were also found to be sensitive to the properties of the galactic locations within which they exploded.

The detailed results of the two analyses can be found in two publications (Maguire et al. 2014, Monthly Notices of the Royal Astronomical Society, and Maguire et al. 2015, Monthly Notices of the Royal Astronomical Society, submitted).

LDSNPS

- ★ Coordinated by the European Southern Observatory in Germany.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/183134

HOW ARE OUR SOLAR SYSTEMS FORMED?

A rapidly rotating disc of gas and dust once turned into planets, comets and asteroids, creating what is now our solar system. To understand this process, EU-funded astrophysicists added a key element to the picture: the heating of small regions in the protoplanetary disc.

Given that compression heats gas, the rotating cloud of gas and dust was heated while the protoplanetary disc contracted. However, once it stopped contracting, stabilised by rotation, it ceased heating and began cooling as it radiated energy away into the near absolute zero space. Eventually, it cooled so much that a new process commenced.

"3D MHD simulations showed how, under specific conditions, large vortices are formed and are capable of trapping dust and concentrating it in planetesimals, comets and asteroids."

Tiny solid flakes and grains formed within it, from which a solar system was ultimately built up. During mass accretion, the magnetorotational instability should have acted, producing turbulence. But the magnetised turbulence dissipated its energy intermittently, determining the structure of accreting regions.

The aim of the project COOKING-DUSTINDISKS (Forming high-temperature solids in protoplanetary disks) was to shed light on this energy dissipation of magnetised turbulence heating the discs locally. To this end, astrophysicists used high-resolution numerical models.

The model predictions showed, for the first time, differential rotation shearing magnetic fields that, in turn, created small regions several hundred Kelvin hotter than the surrounding gas. The temperature variations observed were large enough to have consequences on mineral formation.

Such heating events can play a major role in melting chondrules, remelting calcium-aluminium-rich inclusions and annealing silicates, namely materials found in meteorites. In their efforts to simulate protoplanetary discs, astrophysicists initially studied

a small portion of the disc in order to save on computing costs.

However, global 'magnetohydrodynamic' (MHD) simulations of protoplanetary discs were later carried out and revealed surprising magnetic field structures. A qualitatively different current sheet structure was observed in a largely non-turbulent region driven by processes captured by the generalised local model.

Knowledge gained through work on the role of magnetic fields in protoplanetary discs was then used to explore the Rossby wave instability. This instability can develop during the transition of poorly ionised regions to magnetised zones of protoplanetary discs and contribute to planet formation.

3D MHD simulations showed how, under specific conditions, large vortices are formed and are capable of trapping dust and concentrating it in planetesimals, comets and asteroids. A movie compiled from the simulation results has been uploaded here.

The many fascinating results of COOKINGDUSTINDISKS are described in a series of publications in high-impact peer-reviewed journals. Supported by observations of protoplanetary discs similar to our early solar system, they succeeded in building a better understanding of how an interstellar cloud collapsed to form our solar system.

COOKINGDUSTINDISKS

- ★ Coordinated by the University of Copenhagen in Denmark.
- ★ Funded under FP7-PEOPLE.
- ★ http://cordis.europa.eu/result/rcn/188384


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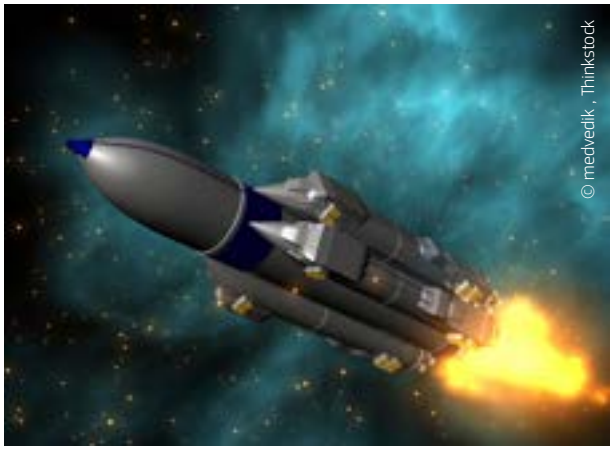
LOW-COST AND LIGHTWEIGHT LAUNCHERS

The aerospace industry is demanding the design of lightweight launchers at a lower cost. An EU-funded initiative has responded with a new design approach for imperfection-sensitive, thin-walled launcher structures.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The NASA SP-8007 guidelines for the design of imperfection-sensitive structures were developed in the late 1960s without considering exciting new developments in lightweight composite materials. Similarly, the space industry's current demand for lower-cost launchers and the ever-increasing payload requirements were not addressed either.

Over recent years, different approaches have been adopted to predict the maximum load for launcher structures. Using non-linear finite element models, engineers have struck a good balance with experimental results. The computational cost of simulations carried out in the pre-design phase is too high when faster and more accurate tools are needed.

Within the DESICOS (New robust design guideline for imperfection sensitive composite launcher structures) project, researchers further developed a deterministic method. The so-called 'Single perturbation load approach' (SPLA) uses the radial profile of a load applied as an indication of the structure's sensitivity to imperfections.

Despite the advantages of this method, a reasonable computational effort still needs to be dedicated to calculating the knock-down factor. In engineering composite structures, the knock-down factor is used to account for the fact that imperfections reduce the stress that these can withstand to a small fraction of the stress at which a perfect structure buckles.

The DESICOS team therefore explored ways to combine SPLA with semi-analytical approaches. With a view to applying the new combined methodology in the preliminary design of launcher structures, it was validated by extensive testing structures made of composite materials. An axially loaded unstiffened cylinder — disturbed by a large enough single perturbation load — was found to lead to a 45 % higher buckling load than in designs based on the existing guidelines.

Importantly, the potential of the new methodology to reduce the development timescales and manufacturing costs, while increasing the payload capacity, was demonstrated within selected case studies. DESICOS' results were published in more than 30 peer-reviewed papers and are summarised in a handbook on the design of composite launcher structures.

DESICOS

- ★ Coordinated by DLR in Germany.
- ★ Funded under FP7-SPACE.
- ★ http://cordis.europa.eu/result/rcn/150524
- ★ Project website: http://www.desicos.eu/

GALAXY CLUSTERS OUT OF EQUILIBRIUM

Galaxy clusters are thought to be the largest gravitationally-bound objects in the Universe. EU-funded astrophysicists have delved into the wealth of available observations to confirm the role of dynamical processes in their evolution.

In galaxy clusters, gravity binds hundreds of thousands of galaxies together in such large collections that the fabric of space-time is distorted. According to present understanding, these massive astrophysical objects take billions of years to form and grow by accreting mass from their surrounding 'intracluster medium' (ICM).

Gas accreted is thought to heat up and slow down in large-scale shock waves surrounding the clusters. The EU-funded astrophysicists identified the signature of such a wave around one of our richest nearby clusters, the Coma cluster, which lies about 100 megaparsecs away from Earth.

In the context of the NEPAL (Non-equilibrium processes in galaxy clusters) project, the astrophysicists discovered its gamma-ray signature through observations from the Very Energetic Radiation Imaging Telescope Array System (VERITAS). This long-anticipated detection tool provides a new cosmological probe of the ICM.

Unlike gas accreted from the ICM, gas at the core of galaxy clusters is expected to cool over time, forming a gas flow cold enough to condense and form new stars. The NEPAL team was able to identify, in high-resolution X-ray, images of the cold front inside the core and sometimes beyond it.

Specifically, shear flow beneath the cold fronts can produce the magnetic fields needed to stabilise it against Kelvin-Helmholtz instabilities. Such shear flow-induced magnetic fields have in the past been reproduced in computer simulations. Their existence had, however, remained unconfirmed.

NEPAL's findings shed new light on the colder core of galaxy clusters where old galaxies sit and within which only a few new stars are born. Follow-up studies with observations at different wavelengths allowed a more complete view of intergalactic matter.

Nonetheless, all NEPAL results confirm the importance of dynamical processes in the evolution of galaxy clusters. In particular, extended spiral flows are intimately related to the clusters' core structure. Research work is still ongoing to develop a self-consistent model of the cool cores based on new analytical and numerical tools.

"NEPAL's findings shed new light on the colder core of galaxy clusters where old galaxies sit and within which only a few new stars are born."

NEPAL

★ Coordinated by Ben-Gurion University of the Negev in Israel.
★ Funded under FP7-PEOPLE.
★ http://cordis.europa.eu/result/rcn/175002

EVENTS

JANUARY
04▸06

Reykjavik, ICELAND

CONFERENCE

KRISTINA/MULTISENSOR SPECIAL SESSION AT MMM2017

The EU-funded KRISTINA and MULTISENSOR projects will host a special session at the annual MMM2017 conference that will take place in Reykjavik, Iceland, from 4 to 6 January 2017.

This special session on multimedia and multimodal interaction for health and basic care applications aims at presenting the most recent works and applications in the area of multimedia analysis and multimodal interaction in the context of health and basic care.

The 23rd International Conference on Multimedia Modelling (MMM) is a leading annual international conference for researchers and industry practitioners for sharing new ideas, original research results and practical development experiences from all MMM related areas.

For further information, please visit:
http://mklab.iti.gr/mmih/

JANUARY
10▸13

Delft, THE NETHERLANDS

CONFERENCE

MPM 2017 CONFERENCE

The EU-funded MPM-DREDGE project will host the international MPM 2017 conference, in Delft, the Netherlands, from 10 to 13 January 2017.

The aim of the conference is to provide an international forum for presenting and discussing the latest developments in both the fundamental basis and the applicability of state-of-the-art computational methods that can be effectively used for solving a variety of large deformation problems in geotechnical and hydraulic engineering.

Special focus is on the numerical modelling of interaction between soils, water and structures where the interface and transition between solid and fluid behaviour plays an essential role.

Active discussion on key topics will be facilitated through invited keynote lectures. Additionally, MPM–DREDGE project partners will present the highlights of their research programme, achieved through intense collaboration between industry and academia.

For further information, please visit:
http://mpm2017.eu/

JANUARY
16▸20

Lanzarote, SPAIN

CONFERENCE

FOURTH SOLARNET PROJECT MEETING

The EU-funded SOLARNET project will host its fourth project meeting in Lanzarote, Spain, from 16 to 20 January 2017.

The purpose of this conference, entitled 'The physics of the Sun from the interior to the outer atmosphere', is to provide a coherent picture of the Sun as a single physical system playing all the underlying physical processes measured and observed in the solar atmosphere to date.

The conference will provide a forum to discuss recent advances in the study of the solar interior, solar dynamics and dynamo, mechanisms of sunspot and active regions formation, and links between the subsurface dynamics, flaring and CME activity. New problems in the study of the solar interior and atmosphere, and of solar dynamics and magnetism will be identified; and collaboration between researchers working on the Sun's interior and solar atmosphere will be fostered.

Graduate students and early-career postdocs are particularly invited to participate to present their research work.

For further information, please visit:
http://www.iac.es/congreso/solarnet-4meeting/

JAN.
23▸25

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

12th HIPEAC conference

CONFERENCE

The Horizon 2020-funded HIPEAC project will be hosting its 12th annual conference in Stockholm, Sweden, from 23 to 25 January 2017.

The HIPEAC conference is the premier European forum for experts in computer architecture, programming models, compilers and operating systems for embedded and general-purpose systems. The three-day event attracts about 600 delegates each year.

Associated workshops, tutorials, special sessions, several large poster sessions and an industrial exhibition will run in parallel with the conference.

For further information, please visit:
https://www.hipeac.net/2017/stockholm/

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NOW ON CORDIS

RESOURCE EFFICIENCY: POWERING GREEN GROWTH FOR EUROPE

Growing demand and global competition for resources have been putting increasing pressure on the natural environment. Europe needs to stay competitive but it must also lead the way in finding sustainable and environmentally-friendly solutions to address these challenges. To square the circle, the EU has chosen to focus on resource efficiency as a Flagship Initiative under its EU 2020 Strategy for Smart, Sustainable and Inclusive Growth. The EU has also embarked upon a Roadmap to a Resource Efficient Europe that would see Europe's economy be transformed into a sustainable one by 2050.

On Friday 28 October, published a new Results Pack that showcases six EU-funded projects that are paving the way in transitioning Europe to a more sustainable and resource-efficient future and lays the groundwork for the development of a truly Circular Economy.

Please see the following link for more information:
http://cordis.europa.eu/article/id/400140-resource-efficiency-powering-green-growth-for-europe_en.html

About CORDIS Results Packs

CORDIS Results Packs are a new set of products grouping EU-funded project results per topic and target audience. The aim is to disseminate information about new studies, scientific findings and technologies to the relevant target audience, in order to facilitate their exploitation across Europe.

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