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SPECIAL FEATURE

POLYMERS AND COMPOSITES RISE TO NEW CHALLENGES



BIOLOGY AND MEDICINE

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CHILDREN SUFFERING FROM
SPINAL CURVATURE**

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EDITORIAL

by the editorial team

REINVENTING PLASTICS TO SHAPE THE 21ST CENTURY

The industry certainly has a point when it presents plastics as the material of the 21st century. Plastics, be it in their purest forms or used in combination with other materials to form composites, are all around us, from the packaging protecting our food to tools used in hospitals, cars and most things we can find in our houses. According to statistics published by PlasticsEurope, some 50 million tonnes of plastics were produced in 2013 in Europe. The sector is directly responsible for 1.45 million jobs, and the association also claims that the sector is amongst the 5 most innovative ones in the EU.

But behind these impressive figures lies a long lasting debate which is largely representative of society's current dilemma: industrial growth historically came at the expense of sustainability, and noble intentions like the creation of a circular economy with sustainable consumption and production patterns requires a major switch in mentalities and practices. In the case of plastics, health concerns, landfilling and worrying trends like the exponential growth of what is commonly called the Great Pacific Garbage Patch have made more headlines and inspired more public debates than any of the

material's acknowledged benefits. Composites, on the other hand, often present unrivalled properties but can hardly be recycled.

Well aware of this trend, the industry has been working hard to restore its image. It constantly invests in R&D to create new products and solutions which would make plastics not only the material of the 21st century as it stands now, but rather that of this same century as citizens and policy makers want it to be.

As with most innovative sectors key to the competitiveness of the EU economy, the FP7 has funded a great deal of inspiring projects. These aim to produce new, more sustainable polymers, improve production techniques or create cutting-edge technologies based on plastics and composites to advance other industrial sectors.

This new edition of the *research*eu results magazine* discusses some of the latest plastic- and composite-

related findings under FP7. It includes four interviews on four different topics which illustrate the tremendous potential of these materials: a new type of bio-based packaging for food products, a composite that enables the production of cheaper bathroom and kitchen furniture without compromising on quality, a new type of lens for people suffering from presbyopia, and new research aiming to bring innovation based on organic semiconductors a step forward.

In addition to the usual thematic sections, this magazine welcomes for the first time a section dedicated to physics and mathematics. This new section will be featured every three months, in rotation with the 'Space' and 'Food and agriculture' sections.

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



Erratum

Our special section on 'Will hydrogen revolutionise our lifestyles?' in REU 38 failed to mention the important contribution of the FCH JU (Fuel Cell Hydrogen Joint Undertaking) to the projects SHEL, TEMONAS, HYTRANSFER and HYTEC. The FCH JU is a public private partnership supporting research, technological development and demonstration (RTD) activities in fuel cell and hydrogen energy technologies in Europe. It aims to accelerate their market introduction and the realisation of their full potential.



Focus on
Hip research
for the young

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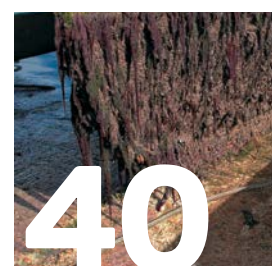
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SPECIAL FEATURE POLYMERS AND COMPOSITES RISE TO NEW CHALLENGES

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INTERVIEW

NEW COMPOSITE MATERIAL PROMISES TO DISPLACE IMPORTS FROM OUTSIDE EUROPE

High-end furniture at low cost might soon become reality thanks to a new composite material developed under the LIMOWOOD project.

Most people have been faced with this dilemma at least once in their life: can I afford the luxury furniture for my new bathroom or kitchen, or should I be coming to terms with it and get the cheapest option at the expense of lifespan? The choice, which is already brain teasing at a personal level, is equally important for the future of the European economy. When choosing between high-end and low-end products, we are often deciding whether or not to support European manufacturers.

Aiming to fill this quality gap while providing the EU industry with the means to fight back against cheaper offerings, the EU-funded LIMOWOOD (Advanced wood plastic composite material for the production of bath furniture resistant to moisture and free of coatings) project is stirring up the hornet's nest with a brand new

composite material made of wood and plastics. The product, which has a large spectrum of applications in sectors ranging from furniture to the automotive industry, aims to provide an affordable solution to displace imports from outside Europe.

The new material displays higher mechanical resistance, increased resistance to moisture, full recyclability, zero VOC emissions and aesthetics as good as that of HPL for a production cost close to that of low-end MDF. Thanks to an EU patent, the team expects the product to generate some EUR 120 million of savings for the European industry while creating new jobs.

Oscar Valdemoros, coordinator of the LIMOWOOD project, discusses the consortium's achievements, the strengths of the new material and its future commercialisation.

★ Are you happy with your achievements under this project?

Oscar Valdemoros: We actually achieved more than what we expected initially. We were only aiming to create a board made by extrusion, but we also managed to create the board by hot pressing, which extends the field of applications. We also reached our objectives in terms of price and quality.

★ So how does Limowood compare to other materials?

What we wanted was to compete with both low-end and high-end materials. Our material is very comparable to HPL in terms of high-end properties, with a price that is more similar to low-end MDF. Also, you can apply any finish on top, from natural wood to decorative films, so it's a perfect substitution for what is currently available on the market. Before, there



© Oscar Valdemoros

OSCAR VALDEMOROS

“Most of the materials used in the production of Limowood come from sustainable sources.”

were other composites, but you could only use them for niche applications like fences, not for kitchens or bathrooms. We managed to fill this gap.

★ **Does Limowood require much investment in tools and machinery?**

This is the beauty of Limowood. Once you have the board, you don't need to invest in anything else. Limowood can be manufactured by both extrusion and hot pressing, using existing machinery, with the only limitation being related to panel size when it comes to extrusion.

★ **Have some companies contacted you already?**

Yes, we have had contacts with big manufacturers, even within the automotive industry, from Europe and overseas. Our dissemination activities, which include attendance at international fairs, have been very successful so far.

★ **When do you hope to see your material being commercialised?**

The prototypes are ready, we have invested in the manufacturing, so now we are very close to it. However, bringing such a product to market takes time and we have to sign agreements with various suppliers. I don't know if Limowood will be commercialised this year, but surely as soon as possible. We have a meeting next week with the partners and all these things will be discussed then.

★ **What's your strategy to attract as many industries as possible?**

The first thing is to get certification for the different applications, and maybe adapt the formulation to the needs and requirements of markets such as the automotive and construction markets.

★ **How does the material perform in terms of sustainability?**

One of the objectives of the project was to use recycled materials as much as possible, with no VOC emissions, in order to comply with European legislation. Now most of the materials used in the production of Limowood come from sustainable sources: the wood is from sustainable forests and we use recycled plastics.

★ **One of your ambitions is to help displace imports. How so?**

Limowood is very competitive with regards to price, while offering the same quality and behaviour of premium but usually expensive materials.

★ **Will this technology be patented?**

Yes, we are taking the necessary steps right now.

★ **With the project now being completed, do you have any follow-up plans?**

The follow-up plan is to start commercialising it as soon as possible. We may have to try taking things a bit further under Horizon 2020, but this hasn't been decided yet. We have been in touch with big European companies which could handle the manufacturing so maybe we won't need EU funding anymore.

LIMOWOOD

- ★ Coordinated by Imec in Belgium.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/project/rcn/106816>
- ★ Project website: <http://www.limowoodcomposites.com/>



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MAKING PLASTICS FROM SEAFOOD WASTE

Researchers in the N-CHITOPACK project have developed new biodegradable food packaging materials from chitin, a common seafood industry waste product. According to the project coordinator, Mavi, the next step is a new project which will work to produce what was achieved in the lab under N-CHITOPACK, but on an industrial scale.



Plastic food packaging presents a significant environmental challenge — plastic is traditionally made from petrochemicals, and it is non-biodegradable, thus contributing to the global waste problem. Recently, scientists have found that chitin from seafood waste can be used to make chitin nanofibrils, a potential bio-based polymer.

The EU-funded project N-CHITOPACK (Sustainable technologies for the production of biodegradable materials based on natural chitin-nanofibrils derived by waste of fish industry, to produce food grade packaging) aimed to use chitin nanofibrils to produce antibacterial and biodegradable bioplastics for food packaging. The project succeeded in producing materials for coffee capsules and food containers.

N-CHITOPACK investigated the end-user requirements for bio-based food packaging through surveys and market analysis. In

conjunction with a literature review, this process revealed the technical requirements for the three different applications. Much of the rest of the project focused on the technical analysis of chitin nanofibrils and chitosan. This revealed that chitin nanofibrils are a safe and efficacious material for food packaging. Researchers also made a number of chitin nanofibril-based plastics for testing. Thermo-mechanical tests on the newly produced compounds were carried out.

N-CHITOPACK generated new, 100% biodegradable bioplastic materials for food packaging and other applications. N-CHITOPACK thin films can be used to pack sandwiches for temporary use, or chocolate tablets for long periods of time. Not only that, but the project has now spawned another EU project which aims to produce what the N-CHITOPACK team created in the lab, but on an industrial scale.

The project also generated some other interesting and as yet unpublished results during the course of its exploration into chitin — the team verified the possibility of using chitin nanofibrils and chitin oligosaccharides as plant biocides and plant growth promoters.

N-CHITOPACK

- ★ Coordinated by Mavi Sud Srl in Italy.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/result/rcn/151596>
- ★ Project website: <http://www.n-chitopack.eu/>

INTERVIEW

LIGHTSWORDS LENS PROMISES TO REDUCE AGE-RELATED DEGRADATION OF SIGHT

Contact lenses that alleviate the symptoms of presbyopia while maintaining correct vision from all distances could soon become a reality thanks to technology developed under the LIGHTSWORDS project.

Whether or not you had to wear glasses or contact lenses when you were younger, the odds are pretty high that somewhere in your fifties your once excellent vision will start declining. Reading newspapers or text messages will suddenly become a challenge that only eyewear, contact lenses or surgery will help you overcome. The condition is called presbyopia, and it affects close to 1 billion people in the world.

With surgery still being in its infancy, glasses are still the most realistic option for many patients. But they suffer from a major drawback: they make it difficult for your eye to focus at different distances, which can be dangerous, especially in the workplace. This is where the EU-funded LIGHTSWORDS (Lens that MIGHT be a Satisfactory Way Of Reducing age Degradation of Sight)

project comes into play, with the promise of a plastic lens allowing for continuous focal adjustment from near-field objects to... infinity.

LIGHTSWORDS is following up on theoretical research that emerged 20 years ago. At the time, the concept of a lens eliminating the need for mechanical focus adjustment had emerged but technology wasn't mature enough to bring this concept from lab to market. The LIGHTSWORDS project has solved this problem with a set of embossing and injecting technologies and a game-changing lens capable of continuously varying optic power from OD to about 3D — making it possible to recognise objects placed at distances of about 33 cm to infinity with a good level of image sharpness.

Krzysztof Grabowiecki, coordinator of the project, tells us about its results and

his plans for further developing the LIGHTSWORDS technology.

★ What are the main objectives of this project?

Krzysztof Grabowiecki: Our objective is to develop the necessary technology for production of a novel optic structure called Lightswords and to have it ready for production. This technology relies on an asymmetric optic structure. This means that the lenses are embedded with extended depth of focus, which could replace zonules of Zinn with crystalline lens for adapting vision to specific needs.

These mechanisms are key to solving problems faced by patients affected by presbyopia. With a single lens, they will be able to observe objects from various distances without a meaningful loss of sharpness, although the result will be



© Krzysztof Grabowiecki

KRZYSZTOF GRABOWIECKI

slightly below that of regular single focus lenses over long distances.

The theory behind the LIGHTSWORDS technology was developed some 20 years ago, but there were no physical applications due to difficulties with lens manufacturing: small curvature continuously varying around the axis and small, sharp steps. Our task was to find the proper technology, which would satisfy at least the theoretical constraints related to manufacturing, and to start up a pilot mass production line.

★ You tested three different technologies. Did one of them stand out? How?

Three technologies (or four, when counting combinations) were indeed used for investigations on possible production of the LIGHTSWORDS lenses: regular micromachining of a single lens which is often used in industrial practice; micromachining with the possible application of EDM for mould die manufacturing (injection technology); laser lithography technology for mould stamp manufacturing (hot embossing technology); and micromachining for mould stamp manufacturing (hot embossing technology).

Finally, micromachining for mould stamp manufacturing was recognised as the best solution. A mould insert with the required precision was manufactured by the consortium and a first injection test batch of lenses was produced and characterised successfully. For optic characterisation, the test bench was set up to simulate human eye vision. Four objects were placed at different distances (0.33 m to 3 m) from the 'artificial presbyopic eye' which is basically a lens focusing on a fixed distance. We observed the correction of vision that we had predicted originally in theory: instead of having a single sharp object and being surrounded by

out-of-focus objects, the artificial eye corrected with the LIGHTSWORDS lens was able to see all four objects with a satisfactory quality — but not optimal — sharpness.

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

The main challenge was to satisfy very narrow levels of tolerances (micron or even submicron) for manufacturing in order to achieve a certain level of smoothness, while still keeping the usual shape and roughness of a lens. In particular, exploiting grey-scale laser lithography for thick photoresist was no easy task. The technology for thick/deep photoresist is not mature enough so our success was only partial in this regard. We were eventually forced to move to a 'semi-refractive' design of the optic structure. Finally, we focused our efforts on the micromachining and successfully reached our objectives.

★ How do your plastic lenses differ from other lenses currently available on the market?

The main thing is that, with our single lens, someone observing a scene can benefit from an extended depth of field. Our primary design relies on optic power 0-3D, which means that the depth of field extends from 33 cm (regular reading distance) to infinity. The present correction concept uses a number of optic structures: bifocal, pinhole, aspheric. However most of them request eye axis movements while, in the case of LSOE, the vision axis remain unchanged.

★ The project ends this month. Does the technology you developed meet your initial expectations?

In principle yes: we have technology ready for pilot production. We are also developing a dedicated testing setup to assess the geometry and optic features of the lenses.

★ Do you have any follow-up plans?

Yes we do. Now that we have developed a real lens, which may be

evaluated by ophthalmologists in clinics and tested by researchers focusing on the brain acquisition of image, experts also expressed interest in contact lenses and intraocular ones. However, novel materials have to be used to take on these challenges.

In parallel, we would like to develop certain CCD camera solutions for free of focus operations including embedded distance metering (rangefinder) and difficult lighting conditions. That would require sophisticated software development and hardware configuration for real-time scene imaging, and such development is ongoing. We will start working on designs for protective goggles where our lenses will be incorporated, and obviously we will attempt to secure new EC funds for these purposes.

★ What do you foresee in terms of market impact? Have some lens manufacturers shown interest in mass-producing your lenses yet?

The impact on the market could be large due to the device's low price and the high functionality embedded in the lens structure. Even more impact could be expected when contact lenses or intraocular lenses are considered; although we still need to wait for clinical results, including restrictions related to certain malfunctions of the human eye. We also see potential in a so-called machine vision solution for better and faster image acquisition or 3D scene analysis. Things like night vision and spectral evaluation of the observed scene could also be considered as the diffractive features of the asymmetric lens are exploited.

We have indeed witnessed some interest from some of the main players on the ophthalmic and camera development markets. However, it is too soon to disclose more information.

LIGHTSWORDS

★ Coordinated by CIM-mes Projekt in Poland.

★ Funded under FP7-SME.

★ <http://cordis.europa.eu/project/rcn/105892>

★ Project website: <http://www.lightswords.eu/>



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SUSTAINABLE CHEMICAL PROCESSES

The recently completed COOPOL project worked to significantly improve industrial polymer processes by developing advanced control and optimisation technologies, ensuring product quality and increased productivity. The process developed by the project team was implemented at a BASF commercial pilot plant, and now BASF is looking to implement it across their production.



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Transition of the processing industries toward a more sustainable manufacturing model is a key priority for the European Research Area and should ensure continued growth and global competitiveness. Achieving this requires adopting novel reactor technologies, greener reactions and an increase in intelligent system use within the processing industries.

"The project team's intensive research efforts were put into practice when the COOPOL process was successfully implemented at a BASF commercial pilot plant."

The EU-funded project COOPOL (Control and real-time optimisation of intensive polymerisation processes) developed new methods and tools for modelling and control, based on real-time sensing. This should facilitate the development of a new paradigm of intensive, low-impact and sustainable chemical technologies.

The project developed a new process control approach for intensified semi-batch and 'smart-scale' continuous polymerisation processes to improve efficiencies, linking molecular-level information on the reaction chemistry with soft sensors, rigorous modelling, subsequent model reduction, non-linear model-predictive control and dynamic real-time optimisation.

After characterising different polymers, scientists produced and validated semi-batch and smart-scale models for online control applications. Emulsion polymerisation intensification was investigated in a smart-scale tubular reactor with static mixers where it was shown that it is feasible to establish a stable process with high solid-content throughput.

Another important achievement was the microsensor development. A soft sensor approach was being developed to process several data together, such as heat flow, surface acoustic wave, temperature and conductivity.

The project team's intensive research efforts were put into practice when the COOPOL process was successfully implemented at a BASF commercial pilot plant. According to COOPOL project coordinator Prof. David Haddleton from the University of Warwick, the implementation was so successful that BASF is now looking to roll it out across their production.

The project also facilitated the exchange of information between experts from the field of emulsion polymerisation, process control and modular reactors, in particular through the Emulsion Polymerisation Conference, organised by COOPOL in partnership with Dechema in January 2015. At the conference, the project partners had the opportunity to present their exciting and novel results to the emulsion polymerisation community.

Added to that, a follow-up project comprising many of the COOPOL project partners has now been successfully funded under the Horizon 2020 programme. As such, COOPOL's work is supporting further progress on the implementation of greener and more sustainable chemical processes.

COOPOL

- ★ Coordinated by the University of Warwick in the United Kingdom.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/result/rcn/151528>
- ★ Project website: <http://www.coopol.eu/>



GREENER POLYMERS

Conventional polymers or plastics are derived from petroleum. Novel biopolymers with enhanced thermal and mechanical properties could provide a sustainable alternative with numerous applications.

Decreasing natural resources combined with increasing concern about product recyclability and environmental impact have spurred the development of biopolymer alternatives that are either bio-based or biodegradable. Although the growth rate for biopolymers in the EU is about 20% annually, poor mechanical and thermal properties or high cost limit their commercial applicability.

EU-funded scientists investigated two different ways of enhancing properties for applications in food packaging and agriculture within the context of the project NANOBIOCOMP (Novel nano-reinforced biodegradable composites: design and characterization). They employed one bio-based, biodegradable polymer ('Hydroxybutyrate-co-hydroxyvalerate' or PHBV) and one petroleum-based biodegradable one ('Butylene adipate-co-terephthalate' or PBAT). The team investigated the effects of modifying them with

various types and percentages of natural clay and blending the two in varying ratios.

Reinforcement of the biopolymers with 3% of the content being organically modified clays (1%, 3% and 5% were tested) produced the best property profile. Thermal stability, crystallisation behaviour and dynamic mechanical behaviour were evaluated. Biopolymer composites consisting of 50% PBAT/50% PHBV demonstrated superior thermal and mechanical properties.

Researchers produced biopolymer composites with half PBAT, half PHBV and reinforced the content with 3% organically modified clays. An antimicrobial agent (propolis) was used as a filler and compared to a commercial agent for reference. The materials were characterised for stability in the face of varying temperature, moisture, microbial and weathering conditions.

NANOBIOCOMP data could help guide manufacturers in the design and use of novel biopolymers for packaging or agricultural foils with enhanced sustainability. Knowledge-based engineering

should significantly improve biopolymer properties, enhancing commercial uptake and thus global impact.

NANOBIOCOMP

- ★ Coordinated by the University of A Coruña in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151411>

"NANOBIOCOMP data could help guide manufacturers in the design and use of novel biopolymers for packaging or agricultural foils with enhanced sustainability."



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INTERVIEW

YET MORE OPPORTUNITIES FOR ORGANIC SEMICONDUCTORS

From 'Radio frequency identification' (RFID) tags to OLED displays and photovoltaic cells, organic semiconductors' high potential is widely recognised. A Marie Curie project has set out to bring innovation to the next level by using nucleation agent additives to better control the physical properties of these systems.

Organic polymer semiconductors are often regarded as high-potential materials by the EU's most innovative industrial sectors. Thanks to their excellent performance in terms of electrical conductivity, thermal stability, compatibility with mechanically flexible substrates, low-cost manufacturing, and easy integration with chemical and biological functionalities, these materials have been on a roll lately. Today, they are mostly known for their promising applications in the development of improved solar cells and flexible displays.

To take these materials to the next level and better face international competition, however, a better control of their physical organisation is required. It is currently impossible, for example, to control the crystallisation of even the simplest 'plastic' — PE — which otherwise would come out as

a much better material than the brittle but commonly used 'polystyrene' (PS). Such control would enable the industry to change at will the physical appearance of an enhanced PE with a high mechanical strength, at a low fabrication cost.

With this objective in mind, the EU-funded CONDPOLYBLENDORD (Controlling the Order of Functional Polymers and their Corresponding Blends) project has been using nucleation agent additives to control system ordering within conducting polymers and their corresponding blends. While small quantities of additives have been used for decades to manipulate the solid-state structure and properties of materials, their application to organic polymer semiconductors would open the way to many innovations in the sector.



NEIL TREAT

The CONDPOLYBLENDORD project was completed in late February. In this exclusive interview with the research*eu magazine, Neil Treat elaborates on his findings.

★ **You claim to pursue the holy grail for the polymer community. How exactly?**

Neil Treat: CONDPOLYBLENDORD utilised the well-known concept of additives to address one of the great challenges in organic semiconductors — controlling their physical organisation. With this project, we wanted to relate molecular order and conformational arrangements to organic conjugate matter with electronic, magnetic and optical phenomena, and aim at developing understanding similar to the polymer mechanics field, where such knowledge led to the development of ultra-high strength polymer fibres, for use in bullet-proof gear as well as superb medical instruments.

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

I became interested in polymers as a first year undergraduate student. I remember making the connection that the polymer systems being researched in my lab would be used to improve life-saving pharmaceuticals. From then on, I never wanted my research to be disconnected or isolated; I felt most inspired when at the forefront of my area of expertise — analysing, questioning and improving technology. My goal as a research scientist became to apply the science that is my passion to the problems and needs of people.

This defining realisation led me to do a Ph.D. at the University of California Santa Barbara, researching a class of solar cells that used polymers as active components. These systems have the potential for cost-effective production over large areas. During my tenure, I was invited to spend two months in the group of Prof. Natalie Stingelin at Imperial College London. Natalie and I began to look into an as yet unexplored idea for the organic electronic community: how to use nucleating agents to influence their structure and electronic properties. Fortunately, we found that this approach was both straightforward and powerful and that it could impact society by enabling more cost-effective production of renewable energy sources. As a result of this experience, I began to pursue opportunities to

further develop this disruptive technology in the field of organic electronics.

★ **How does your approach differ from current uses of additives?**

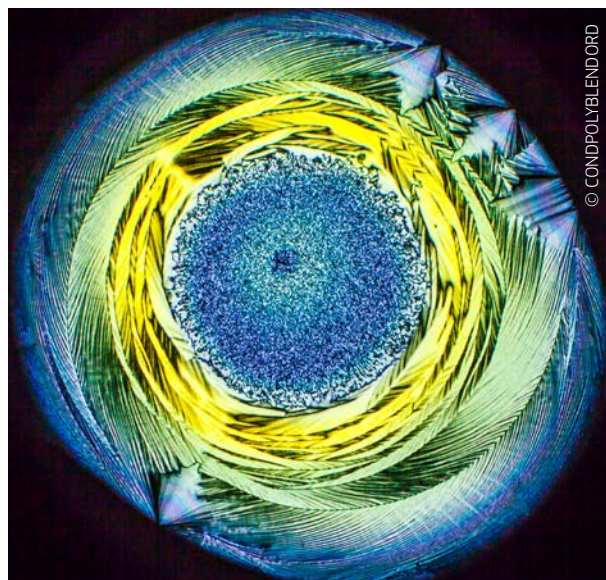
The approach advanced by CONDPOLYBLENDORD applies a strategy widely exploited in classical polymer systems to the new material systems that are organic semiconductors. This approach involves the addition of high surface area additives, which increase the volume of nucleation sites within the host material, and, as a result, control the latter's crystallite size. Thus, due to their simplicity and versatility, our findings have begun to catalyse further studies in organic semiconductors carried out by device engineers (e.g. developing processing protocols) and physicists (e.g. understanding microstructure/charge transport relationships). Other potential applications within this area include the use of nucleation agents to control the phase morphologies of active layers in organic photovoltaic cells, where a fine distribution of the active components is believed to be beneficial. In principle, nucleation agents control the size of the crystalline domains in such materials, which enable exploitation of these additives for the production of photonics structures, and also more fundamental studies including elucidation of the influence of grain boundaries on charge transport in organic semiconductors.

★ **How close are you to project completion?**

CONDPOLYBLENDORD was completed at the end of February and we have achieved the objectives that were laid out at the beginning of the project. The findings from the project will be widely applicable to other functional systems (e.g. ferroelectrics, magnetic organics, nanomaterials, etc.) and it is our hope that our work will stimulate other groups to pursue this strategy.

★ **What kind of windows of opportunity do your new nucleating agents open for industry in Europe?**

CONDPOLYBLENDORD has truly underlined the importance of converging research, technology and innovation to further assist in the transformation of the polymer industry from commodities towards life-changing products while actively integrating them into the EU's PV sector. I aimed to contribute to the fundamental knowledge of semiconducting polymers and their corresponding blends by controlling the morphology within these systems through the use of



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nucleating agents — an approach that had never been investigated and utilised in semiconducting polymers and their corresponding blends before.

Controlling the nano-morphology of conducting polymers and their blends is still essential to enable further development in the field of organic electronics. Thus CONDPOLYBLENDORD was designed to significantly contribute to the

European organic electronic research and industry sector by advancing the understanding of how to control the morphology of polymer-fullerene blends. I also attempted to harness rich, interdisciplinary expertise in chemistry, engineering and physics, which enabled me to gain a better understanding of the requirements for nucleation and allowed me to design new materials that, eventually, may lead to the development of new opportunities that make straightforward, large-area specialty products possible and, thus, will strengthen Europe's long-standing position in state-of-the-art manufacturing.

“CONDPOLYBLENDORD has truly underlined the importance of converging research, technology and innovation to further assist in the transformation of the polymer industry from commodities towards life-changing products.”

★ When do you expect your research to impact the market?

Products comprising organic semiconductors such as 'Organic light emitting diodes' (OLEDs) are already being used in our everyday lives, for instance in mobile devices. CONDPOLYBLENDORD focuses on the fundamental aspects of how to control the crystallisation of this class of functional materials. We believe that our findings will contribute to facilitating further technology developments. It is our hope that nucleating agents will improve the commercial viability of other material systems by addressing issues like batch-to-batch reproducibility.

★ What are the next steps for the project, and do you have any follow-up plans after its end?

Through the Centre of Plastic Electronics at Imperial College London, we will continue to use nucleating agents as a strategy to control the crystallisation and microstructure formation within emerging technologies such as perovskite photovoltaic cells.

CONDPOLYBLENDORD

★ Coordinated by Imperial College London in the United Kingdom.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/project/rcn/103175>

MAKING MORE PACKAGING RECYCLABLE

Recycling is a hugely important aspect of creating sustainable lifestyles for citizens and transforming the EU into a truly circular economy. However, the materials used in packaging can often put up barriers to recycling. The EU-funded project ADCELLPACK aimed to address this problem by developing 100% recyclable cellulose packaging.

According to Eurostat, there are more than 15 million tonnes of domestic plastic packaging waste in Europe, 40% of which is disposed of and not recovered or recycled. The EU is aiming for an 80% increase in the recycling and preparation for re-use of packaging waste by 2030 (60% for plastics by the end of 2030). Food packaging often includes ink, glue or other materials that frequently make recycling expensive and sometimes impracticable. If we are to reach these ambitious targets, then we need to take a close look at the materials used in packaging and explore adjustments or alternatives, and that's exactly what the EU-funded project ADCELLPACK (Advanced cellulose packaging) has been doing.

The use of bio-based materials is a promising alternative in the packaging industry for reducing the disposal and use of non-renewable resources. In fact, a 5% substitution of these materials using 'Modified atmosphere

packaging' (MAP) applications would see a more than 300 000 ton reduction in the amount of non-renewable plastic packaging waste disposed of.

The ADCELLPACK consortium comprised four SMEs, one large enterprise and two Research Centres — all of which have expertise in paper production, bioplastics processing, packaging materials conversion and cheese production.

ADCELLPACK, which concluded at the end of 2014, tested advanced cellulose packaging on the packaging of ready-to-eat cheese slices. The project worked on the basis that by making changes to ingredients in a manufacturing process called 'thermoforming', the packaging trays could be 100% recyclable. Bio-based (cellulose) materials combined with polyesters can be an excellent substitute for non-recyclable polymers. ADCELLPACK developed a new thermoplastic material based on wood fibre for food packaging.



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The ADCELLPACK project was presented at Interpack in May 2014 in Düsseldorf, Germany, said to be the most important packaging trade fair in the world.

ADCELLPACK

★ Coordinated by ITENE in Spain.

★ Funded under FP7-SME.

★ <http://cordis.europa.eu/result/rcn/151348>

★ Project website: <http://www.adcellpack.eu/>

★  <http://bit.ly/1FGz5Nm>

INTERVIEW

COULD PBS REVOLUTIONISE FOOD PACKAGING AS WE KNOW IT?

The SUCCIPACK project has come up with a technical solution to progressively phase out fossil fuel-based packaging in favour of bio-based solutions. The new, biodegradable and recyclable packaging also promises longer shelf life and better protection of food products.

Each year, the average EU citizen generates some 159 kg of packaging waste, around 40% of which is not recycled. As the world population and the Pacific trash vortex keep growing, any packaging option that would tick the recyclability and biodegradability boxes while maintaining or even improving product protection and preservation would be celebrated.

Well aware of these high hopes, 18 companies from across Europe have teamed up to create innovative food packaging materials based on polybutylene succinate — more commonly known as PBS. The consortium has spent two years tweaking PBS grades, structure, formulation, treatment and recycling routes to make the material suitable for a wide adoption by the food packaging market. All this, while keeping investment costs on the low.

The stakes are high: if successful, the commercial deployment of PBS in industry would provide Europe with a competitive edge over the USA and Asia, while bringing the EU one leap closer to the advent of the circular economy.

Christophe Cotillon, who coordinated the project on behalf of ACTIA, details the specifics of the EU-funded project SUCCIPACK (Development of active, intelligent and sustainable food PACKaging using PolybutyleneSUCCInate) and its technology, and discusses its potential for large-scale commercialisation over the next two years.

★ **Packaging is generally seen as trading sustainability for increased food safety. How does your technology reconcile both?**

Christophe Cotillon: PBS-based packaging is able to offer a very good quality of packaging for food, which doesn't have to shy away from comparisons with existing packaging especially with regards to meeting food safety requirements. By improving the barrier properties of this new packaging, the shelf-life of food products can be improved, and as we develop multi-functionality only one film will be needed to protect the food product, thus eliminating the need for different layers of packaging and over-packaging.

In this respect, SUCCIPACK's packaging is contributing to the protection of our environment. But it is also biodegradable and can easily be recycled.

★ **What are SUCCIPACK's expected benefits?**

PBS-based packaging has been tested on different food products such as cheese, ready-to-eat vegetables, meat and fish products. The expected benefits in terms of shelf life are at least comparable with existing packaging and



© Christophe Cotillon

CHRISTOPHE COTILLON

sometimes even perform better. By continuing to improve barrier properties like antimicrobial coating and other aspects (gas, vapour, aroma), we will be able to achieve better preservation of food products compared to existing food packaging.

★ **Why choose PBS as a material?**

PBS is a platform component having applications in different industrial sectors. It is already used by the petrochemical industry, but it can also be 100% bio-based. Bio-based PBS can be produced easily from cellulosic material and renewable sources of plant biomass, be it plants or plant waste. In the future, we expect the capacity of production to increase, so availability of bio-based PBS will not be a problem.

★ **Your website mentions the expected impact of your technology on SMEs. Can you elaborate on that?**

Packaging producers can use PBS packaging to produce films, trays and pouches with the exact same technologies they are using for current packaging materials — injection, moulding, extrusion film blowing and thermo-forming. They don't need to change the process, and switching to PBS only requires very limited investments. This means that SMEs can produce this packaging easily, at a competitive price.

Now, for SMEs producing food, replacing existing packaging by SUCCIPACK packaging will not be a problem either in terms of process. At the end of the day, the only change is better preservation, a longer shelf-life and lower-priced food products.

★ **When do you hope to see your packaging material being commercialised?**

Our packaging should be commercialised in two years. In the early stages, the PBS used for packaging fabrication will not be 100% based on bio-material. It will be a mix of petrochemical and bio-based raw materials.

Then, progressively, PBS packaging will contain more and more PBS from bio-based material because the production capacity for PBS will increase in Europe.

★ **Supposing that the product is successful, can it be produced on a large scale?**

Large-scale production depends on raw bio-based material availability if we want to produce 100% bio-based packaging, but in the meantime petrochemical PBS can be produced on a large scale.

★ **With the project now being completed, do you have any follow-up plans?**

We would like to set up a new project like a 'fast track to innovation' project supported by the EU to reach and

penetrate the market more easily. The existing consortium consists of relevant and efficient partners who are very

"SMEs can produce this packaging easily, at a competitive price."

motivated to keep going further until commercialisation is achieved.



SUCCIPACK

- ★ Coordinated by ACTIA in France.
- ★ Funded under FP7-KBBE.
- ★ <http://cordis.europa.eu/project/rcn/101826>
- ★ Project website: <http://www.succipack.eu/>
- ★ <http://bit.ly/1CB9VBm>

FROM CRAB SHELLS TO RAW MATERIALS

Crab is a culinary delicacy most of which ends up in the bin. However, there are uses for the hundreds of thousands of tons of crab shells thrown away by European consumers every year.

In a lab in Bavaria, scientists are trying to chemically transform crab shells into a high-performance biopolymer. The EU-backed research project CHIBIO (Development of an integrated biorefinery for processing chitin rich bio-waste to specialty and fine chemicals), turns the waste into a raw material and energy source. The first step is to extract the substance chitin from the shells. After cellulose, chitin is the most abundant biopolymer on earth.

'Shrimps, crabs, crustaceans... a large proportion of their body weight contains chitin,' says Prof. Dr Volker Sieber, a biochemist in Fraunhofer IGB's CHIBIO project.

'Chitin is a polysaccharide, a polymer, which is composed of sugar molecules. Sugar molecules can be chemically or biotechnologically engineered to produce different molecules.'

Crab shells contain other non-renewable biological substances. They can be used

to produce biogas, thus becoming a viable energy source. Meanwhile, biochemists from Munich have developed optimised yeast strains to convert the chitin, through fermentation, into fatty oils. The process takes between five and seven days.

'Once we've chosen the different yeast strains by fluorescence testing, we will intensify them in a fermenter to help produce enough oils for further experiments,' says Dr Daniel Garbe, a biochemist at Munich University of Technology.

'These oils will be given to our partners in the industry to be processed. The oils we get through this procedure look like these samples.'

The oils are sent to a partner company in northern Germany. Dr Matthias Ullrich, a chemist with Evonik Industries, explains the process: 'At this facility, we process the natural oil obtained from crab shells, a reaction takes place under high pressure and we obtain the raw material for our plastics.'

The oil is transformed into a pure chemical, the raw material for the production of plastic. The next step is what is called polymerisation. The high-performance biopolymer is produced in a reactor at temperatures of up to 300 °C. It is then chopped into granulates.

'We use this reactor, which can be thought of as a pressure cooker, and we fill it with raw materials,' says Dr Ullrich. 'This raw material is what we transformed from the natural oil into a pure chemical by catalysis. After the reaction, we obtain a high-performance plastic, which is cooled in water.'

The biopolymer is then moulded into sample pieces for quality control; they are thoroughly tested.

From simple crab shells and a complex chemical process, we finally end up with a high-performance product, a raw material for the future, according to Dr Joachim Leluschko, an engineer with Evonik Industries: 'What is interesting with biopolymers is that we don't use any plants that are also used as a food source. We have a number of projects where we use organic wastes. Waste that would otherwise be destroyed can be used as a natural raw material to make plastics in the future.'

This new raw material could be used in plastic products in the very near future.

CHIBIO

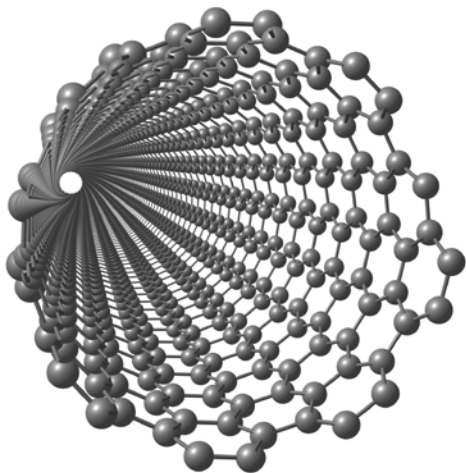
- ★ Coordinated by Fraunhofer IGB in Germany.
- ★ Funded under FP7-KBBE.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?article=33117
- ★ Project website: <http://www.chibiofp7.fraunhofer.de/>
- ★ <http://bit.ly/1CmGmAE>



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DRUG DELIVERY VIA NANOTUBES

Nanotube structures have unique physical and chemical properties that are different from their bulk counterparts. Polymeric nanotubes show great potential as biomedical devices due to their biocompatibility.



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Metal and semiconductor nanotubes are being used as sensors, optoelectronic devices and transistors. The EU-funded SRPNICVD (Stimuli responsive polymer nanotubes by initiated chemical vapor deposition) project aimed to develop polymeric nanotubes as

carriers of macromolecules and study their characteristics. The team worked to optimise the temperature and pH-dependent release of model molecules.

Researchers built a custom-made vacuum deposition chamber for the synthesis of the polymeric nanotubes. They selected criteria for the development of stimuli responsive polymers, the selection of the monomers and the methods for fast deposition.

Thin films of these polymers were synthesised on silicon wafers and chemical characterisations were performed. Nanotubes of temperature responsive polymers were successfully fabricated and characterised. Loading and release performance of the fabricated nanotubes were studied using a model dye. The results showed high rates of loading and

release for the polymers with optimised chemical composition.

The following stage of the project focused on nanotubes that were activated by temperature or pH changes in the environment for macromolecule uptake and release.

Project activities should help enhance our understanding of the mechanisms involved in the uptake and release of the molecules by the nanocarriers. Producing nanotubes with improved performance could have a significant impact when used as drug delivery systems or sensors.

SRPNICVD

- ★ Coordinated by Sabancı University in Turkey.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151690>

ENHANCED POLYMER PROCESSABILITY

Polymers form the basis of numerous products made from melted polymer mixtures. New research supports the potential of a processing treatment to decrease viscosity, opening the door to novel formulations with high-tech fillers.

Polymers, often called plastics, have become ubiquitous. They are in products ranging from food and beverage containers to automotive components and consumer electronics and are a major pillar of the EU economy. Viscosity plays a critical role in processability, as a polymer melt is typically employed to fill a mould. High viscosity (internal friction and resistance to flow) affects processing temperature, cycle time, productivity and product quality.

“SISAPEM outcomes are expected to spawn a flurry of research and discovery, and superior components for high-tech devices could be just around the corner.”

Low-frequency pulsed shear and extensional mechanical treatment helps reduce shear stress. This could help in orienting the melt during extrusion (sustained orientation or disentanglement of the normally tangled polymer chains). However, this topic is surrounded by controversy given its contradiction of established theories. EU-funded scientists investigated the physical mechanisms of sustained orientation with the project SISAPEM (A contribution to the fundamental understanding of Shear-Refinement of polymer melts by entanglement manipulation).

Researchers made an inestimable contribution to the field of polymer science by verifying the existence and mechanisms of sustained orientation. Decreasing the viscosity of high-tech polymer mixtures with high concentrations of

fillers including carbon nanotubes opens important new markets for the polymer industry. These include the production of flame retardants and components with high electrical conductivity.

Future research will focus on controlling the viscosity of polymer melts using low-frequency pulsed shear and extensional mechanical treatment during processing. SISAPEM outcomes are expected to spawn a flurry of research and discovery, and superior components for high-tech devices could be just around the corner.

SISAPEM

- ★ Coordinated by the University of the Basque Country in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151183>



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BIOLOGY AND MEDICINE
MAGAZINE EXCLUSIVE

NEW DEVICE RELIEVES CHILDREN SUFFERING FROM SPINAL CURVATURE

Affecting 2 to 3 % of children between 10 and 16 years old, 'Adolescent idiopathic scoliosis' (AIS) could until recently only be treated with bracing or heavy surgery — often with mixed results. The STIMULAIS project, which has just been completed, promises to improve the condition of these patients with an implantable electro-stimulation device.

© STIMULAIS

Many teenagers would probably argue that this period of life is often synonymous with self-questioning and frustration, and this is even truer for those of them suffering from AIS. In 2015, being affected by spinal curvature doesn't leave much room for hope of better days. Of the two therapies available, one — bracing — involves years of treatment, but does not reduce the deformity of the spine. Surgery, on the other hand, is a very aggressive, last-resort option, and comes with high risks of long-term side effects. In both scenarios, the physical pain is accompanied by serious psychological and emotional problems, notably low self-esteem.

'Current treatments have been demonstrated not to be effective, leading in around 20–22% of cases — where curvature progressed over the safety threshold — to invasive surgery, which in turn presents high risk of complications, including infection, hardware breakage, pseudoarthrosis, nerve damage and sexual dysfunction,' explains Prof. Carlos Barrios, director of the Institute for Research on Musculoskeletal Disorders in Valencia and head researcher of the EU-funded STIMULAIS (A novel muscular micro-electro-stimulation device for the enhanced treatment of adolescent idiopathic scoliosis avoiding bracing and invasive open surgery) project.

A new hope for patients

To relieve teenagers suffering from AIS and spare them surgery, the STIMULAIS consortium has spent the past two years working on an alternative treatment based on 'Functional electrical stimulation' (FES). During its final conference, which took place in January, the project announced that it had developed a novel implantable device capable of stopping curvature progression by using micro-electric stimuli.

'Recent findings have shown that AIS is a musculoskeletal expression of a central nervous system disorder, in other words a neurological disease,' explains Prof. Barrios. 'Such neurological dysfunction affects some deep paraspinal muscles, inducing an imbalance of forces acting on the vertebral segments. With this in mind, we created an implantable device which works by electro-stimulation of specific key muscles that have been demonstrated to play a relevant role in scoliosis deformity.'

Once configured and implanted, thanks to minimally invasive surgical instruments also developed by the project team, the device engages in and analyses electromyographic activity using a specific algorithm. It is then capable of adapting its stimulation patterns to the actual state of the target muscles in real time, while selecting specific muscles for targeted stimulation in order to maximise treatment outcome.

The STIMULAIS prototypes, which were tested on animals in accordance with the recommendations of the ethics committee, can be controlled remotely using a 13.56 MHz near-field transponder system which also transmits the recorded data wirelessly. The device includes a battery able to operate for up to several weeks, after which it needs to be recharged with a wireless, inductive-coupled charging system.

From testing to production

Although promising, the device still needs further testing before it can be implanted in patients. 'We have met the initial objectives and our proposal is significantly closer to commercialisation. Now our next objective is to produce an industrially validated system with specialised providers within the next two years and perform clinical trials, which are expected to last for another three years. So, being realistic, commercialisation could occur in a minimum of five years, depending on the outcomes of these key steps,' says Prof. Barrios.

In addition to replacing conservative treatments like bracing, STIMULAIS is expected to help reduce the financial burden of AIS in Europe. Surgical invasive treatment is indeed very costly, and the effectiveness of the new device, when compared to bracing, could reduce the need to resort to this aggressive treatment.

STIMULAIS

- ★ Coordinated by Tequir in Spain.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/project/rcn/105659>
- ★ Project website:
<http://www.stimulais.com/>

NEW SURGICAL TOOL MINIMISES CROSS-CONTAMINATION RISK

Sometimes a simple cast is not enough to fix a broken bone. Surgery may instead be necessary to insert a nail into the bone and stabilise it. An EU-funded project has developed a prototype of a surgical tool for such operations that will help prevent potential cross-contamination. Thanks to a novel welding method, the new tool does not have any crevices where bacteria can hide and is also easier to clean than traditional tools.



To make room for that nail, surgeons use an 'intramedullary reamer' to drill deep into the marrow cavity of the bone. The tool can ream along the natural curvature of the bone.

In surgery, the reamer's shaft bends as needed. The problem is that bending opens up the shaft in places, similar to what happens when a spring is bent, potentially allowing blood and bacteria to enter. However, once the tool is straightened, the little crevices disappear, making traditional reamers extremely difficult and expensive to clean and sterilise. While hospitals try to ensure sterile operating conditions, there is a slight risk that bacteria and bodily fluids from one patient may stay on the instrument, and that they may be transferred to the next patient, possibly leading to cross-contamination.

Single-piece precision

The researchers and SMEs in the CLEANTOOLS (Crevice-free, high reliability bi-metallic surgical instruments manufactured from shape memory alloys) project picked up from where the traditional technology had left off. 'We wanted

to create a reamer with a flexible shaft in the middle, but made of one single piece,' explains Rainer Siring, managing director at German surgical tool

supplier SIMEX Medizintechnik. That way, dirt, bacteria and blood would have nothing to cling to.

For the shaft of their innovative reamer, the project partners used shape-memory nitinol, a metal alloy containing

nickel and titanium that remembers its original shape. It is flexible enough to follow the curve of the bone, but will straighten when exposed to heat during steam pressure sterilisation.

However, nitinol is too soft to cut into bone marrow, so a cutting tip and an end element made of stainless steel are needed. To join these two materials without mechanical joints or coupling, which would again create little nooks for bacteria, CLEANTOOLS developed a novel rotary friction welding method.

Spinning into gear

Rotary friction welding does not require melting — the materials remain solid. Two cylindrical bars are positioned in one line. One of the bars then starts rotating at high speed, while their tips are brought together with a certain amount of pressure and for a certain length of time. The two materials eventually come together, as if they were made from one piece.

Once they had found the winning combination of materials and method, the CLEANTOOLS partners created a prototype reamer which they went on to successfully test. But Siring expects that they will have to put in another one or two years before the tool is market-ready.

'We have to manufacture the reamer in different sizes and maybe different lengths, since bones differ in length and diameter, obviously,' says Siring. 'Some people are tall, others are short — and there has to be a tool to fit everyone.' The project team is working with potential business partners to find cost-effective production options. At the same time, they are looking for licensees interested in manufacturing such products themselves or having them manufactured for them.

Last but not least, their new tool has to meet the regulatory requirements laid down for medical devices. 'That alone can take between 6 and 12 months,' Siring points out. 'Among other things, we have to do clinical trials, which can be quite difficult and expensive. Therefore, it is possible that we may even have to wait a little longer for commercialisation.' But despite the lengthy approval process, the reamer should be market-ready within a maximum of two years.

"The project team is working with potential business partners to find cost-effective production options."

CLEANTOOLS

- ★ Coordinated by Corin Limited in the United Kingdom.
- ★ Funded under FP7-SME.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33577
- ★ Project website: <http://www.cleantools.de/>
- ★  <http://bit.ly/1Cn1rU>

IMPROVING DEMENTIA CARE WITH PATIENT-FOCUSED APPS

EU-funded researchers have developed new apps that enable healthcare workers to provide more personalised care to dementia sufferers.

The apps, developed through the EU-funded MIRROR (Reflective learning at work) project, have been designed to enable workers in residential homes to be more creative and effective in delivering person-centred care. The Carer App, for example, supports a range of functions, including creating new solutions to challenging behaviours and recording good care practices.

One interesting feature of this app is a service that allows care staff to describe a problematic situation they are facing and then automatically retrieve similar case studies in a matter of seconds. Carers can then browse through these case studies and select one or more that are appropriate to their situation. Based on the recommendations provided, they can implement relevant good practices.

This is important, as carers specialising in dementia need advice and information quickly, and they need it delivered *in situ*, around the clock. The app also generates content in the form of cognitive creative tasks to help care staff in their work.

The project, which began in July 2010 and ended in June 2014, carried out

trials of the new technology at a residential care home in the UK. The responses, some of which can be viewed on YouTube, help to highlight the success of the project in achieving its objectives.

Carers found that using a portable touchscreen iPod — essentially an iPhone without the phone function — enabled them to enter information into the centralised system in rapid time, and likewise receive information in real time. Furthermore, being portable meant that workers did not have to interrupt their care activities in order to take notes or find documentation. This gave carers more time to spend with residents, compared to before when they had to carry around large folders.

The demonstration also found that individuals were well-versed in using touchscreen applications. As a result, there was high acceptance of the technology in the workplace.

The portable, digital application also provided carers with an extra tool to help engage and stimulate patients. A person's life history as well as Google maps, videos and digital photos can be uploaded onto the touchscreen

iPod. Having all these resources at hand means that communication can be much more spontaneous, in turn helping carers and dementia patients connect.

“The MIRROR project has pioneered a new technology-enhanced learning approach to challenging working situations”

The MIRROR project's overall objective was to empower and engage employees across a number of sectors through capturing and sharing the experiences of others. The development of apps capable of facilitating learning in the social care sector formed an important part of the project. Another app, called CaReflect, was also developed to support care staff and reflective learning in residential care homes.

This app automatically calculates the time that care staff and residents are in contact with each other. Care staff and residents all wear their own sensor, similar to a badge. After each shift, carers can log on to the secure CaReflect system to see and review their own contacts.

Through the development of these and other apps, the MIRROR project has pioneered a new technology-enhanced learning approach to challenging working situations where no teachers and no formal content are available.



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MIRROR

- ★ Coordinated by IMC Information Multimedia Communication in Germany.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/news/rcn/122127>
- ★ Project website: <http://www.mirror-project.eu/>
- ★ <http://bit.ly/1wHpWe>

MICRORHEOLOGY — STUDY OF COMPLEX MEDIA

Scientific advancements have provided unparalleled insight into the structure of the cytoskeleton, the fibrous network of proteins inside the cell. However, our knowledge about its dynamic physical and mechanical properties remains limited.

Funded by the EU, the project ACTIVE (Active microrheology for probing stress transmission in complex media) employed passive and active microrheology to *in vitro* reconstituted cytoskeleton networks to find answers. Microrheology techniques can help determine the bulk and local properties such as viscoelasticity of a material after measuring colloidal probe particle motion in a sample.

The idea was to use a minimal set of selected proteins to reconstruct the cytoskeletal network, and determine their roles and properties.

“ACTIVE tools enabled the characterisation of complex fluid structures such as biological cells.”

In this regard, researchers needed to prepare and characterise actomyosin networks, construct optically-based active microrheology set-

ups, and implement relevant analytical software and methodology.

Researchers successfully developed a confocal imaging system with holographic optical tweezers for 3D optical trapping and imaging at the micron scale. Potential applications include fabrication of colloidal-based photonic devices, 3D active microrheology and high-throughput studies of single biological cell dynamics.

Using an *in vitro* cytoskeletal model system, researchers studied the role of the protein myosin II in cytoskeletal network evolution, structure and dynamics. This protein is capable of facilitating self-assembly and self-organisation of the cytoskeleton through cross-linking and regulation of actin.

Project members used microrheological measurements of F-actin networks to determine the non-linear response of such complex systems to perturbations. A two-fluid model was used to compare theoretical and experimental data on viscoelastic properties at the bulk and local levels for differing mesh sizes. Good correlation was found between the experimental and theoretical results in the intermediate regime response.

ACTIVE tools enabled the characterisation of complex fluid structures such as biological cells. Other applications include viscoelastic measurements and rheological characterisation of complex media such as protein, polymer and surfactant formulations. This should be particularly useful for the biomedical, chemical and pharmaceutical sectors.

ACTIVE

★ Coordinated by Tel Aviv University in Israel.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/result/rcn/151721>

TACKLING PARKINSON'S WITH TARGETED THERAPEUTIC VACCINES

EU-funded researchers are behind a pioneering clinical trial that could one day offer Parkinson's disease sufferers a new lease of life.

Clinical trials are about to begin on a new Parkinson's disease vaccine that could offer patients significant improvements over current treatments. The vaccine, developed through the FP7-funded SYMPATH (Reach α -synuclein-dependent neurodegeneration: clinical development of therapeutic AFFITOPE vaccines for Parkinson's disease and multisystem atrophy) project, may actually be able to modify disease progression, rather than simply providing symptomatic improvement.

The breakthrough could improve the lives of hundreds of thousands of people. Parkinson's disease is the second most common neurodegenerative disorder among the elderly; it has been estimated that there are around

1.2 million patients in Europe alone. There is currently no cure, and existing therapeutic measures are only able to treat symptoms. The disease typically starts with non-motor symptoms, and progresses slowly but steadily towards a debilitating state.

The provision of healthcare for the elderly has also become a pressing social and economic concern. By 2025, more than 20% of Europeans will be 65 or over, with a particularly rapid increase in the number of over 80s. An ageing population means increased incidences of physical, sensory and mental diseases. If Europe is to maintain manageable healthcare costs and ensure a decent quality of life for millions of its citizens, then diseases like Parkinson's must be tackled.

This has been the objective of the SYMPATH project. Although therapeutic vaccines have been the subject of intensive research for neuro-



degenerative disorders, no concept has as yet entered into clinical practice.

“The SYMPATH project will help to meet public health needs and contribute to the sustainability of European healthcare systems.”

The new vaccine works by targeting a specific protein called alpha-Synuclein, which plays a key role in the onset and progression of Parkinson's as well as 'Multiple system atrophy' (MSA). MSA is a rare neurodegenerative disorder that progresses rapidly, usually leading to death within nine years. It is associated with the degeneration of nerve cells in specific areas of the brain, causing problems with movement and balance.

These randomised, placebo-controlled trials will be conducted in Vienna and Innsbruck, Austria. The trials aim to demonstrate the safety and tolerability of the vaccine, and researchers will also assess the vaccine's immunological and clinical activity in vaccinated patients.

SYMPATH builds on the fact that vaccines have a particularly attractive cost-effectiveness ratio. Their protection rate is usually high, side effects are minimal, and vaccines only need to be administered a limited number of times. The cost-medical benefits ratio of a therapeutic vaccine is therefore unlikely to be met by any other form of treatment currently under development. The SYMPATH project will therefore help to meet public health needs and contribute to the sustainability of European healthcare systems.

The start of the clinical trial comes only a year after the SYMPATH consortium was launched, reflecting the high level of cooperation achieved between the expert partners. Scheduled to run until September 2017, the project has received nearly EUR 6 million in EU funding from the Seventh Framework Programme (FP7). AFFiRIS, located in Vienna, Austria, is the coordinator for the project's ambitious research programme. Project partners include five universities and three SMEs from across Europe.

SYMPATH

- ★ Coordinated by AFFiRIS in Austria.
- ★ Funded under FP7-HEALTH.
- ★ <http://cordis.europa.eu/news/rcn/122216>
- ★ Project website: <http://www.sympath-project.eu/>

A NOVEL OXYGEN SENSOR FOR BRAIN FUNCTION

A European consortium has developed a novel oxygen sensor to evaluate the impact of cellular bioenergetics in the propagation of neurological disorders.

A common feature of neurodegenerative disorders and ischaemic stroke is the apoptosis of neurons by as yet unknown mechanisms. Overall, our understanding of the events that lead to neuronal injury after stroke is rather limited. Despite improvements in prevention and emergency treatments for stroke, current regimens are largely ineffective in addressing the cause of stroke.

Similarly, available treatments for neurodegenerative disorders target only disease symptoms and not the underlying causes. There is a great need for improved diagnosis at earlier time points, considering the disability of patients suffering from stroke or neurodegenerative disorders.

To address this requirement, the EU-funded OXY-SENSE (A biosensor, image analysis, and work flow system platform for the study of neuronal injury and assessment of cellular bioenergetics) project proposed to develop a novel diagnostic oxygen sensor for evaluating mitochondrial function. Since oxygen is central in cellular bioenergetics, the concept behind this industry-academia alliance was to investigate its role in the pathogenesis of stroke and neurodegeneration.

Partners tested a number of sensors in confocal cell imaging approaches for *in vitro* cultures and *in vivo* imaging. Targeted oxygen-sensitive probes, image analysis software and systems modelling were among the project deliverables.

Most of the chemical compounds developed in the biotech and pharmaceutical industry fail to enter the clinical phase due to intrinsic toxicity. As a result, more integrated,



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“The OXY-SENSE technology provides a diagnostic analyses platform for assessing mitochondrial dysfunction, cellular bioenergetics and drug toxicity.”

effective test systems for drug toxicity analyses are required alongside new quality assurance guidelines. Project partners addressed the pharmaceutical industry's need for toxicity screening.

The OXY-SENSE technology provides a diagnostic analyses platform for assessing mitochondrial dysfunction, cellular bioenergetics and drug toxicity. Implementation of this tool could provide new insight into the causes of neurodegenerative disorders and stroke with potential therapeutic implications.

OXY-SENSE

- ★ Coordinated by the Royal College of Surgeons in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151695>

IMPROVING COCHLEAR IMPLANTS

An EU-funded study has enhanced understanding of the neural processing of sounds by 'cochlear implants' (CIs). This work has led to cutting-edge technologies to measure brain response to sound in CI users.

CIs have changed lives by allowing deaf people to understand speech and communicate in quiet environments or over the telephone. The EU-funded LFAA study (How do low frequency acoustic cues improve speech recognition and music appreciation for cochlear implant users?)

advanced understanding of the brain's processing of sound.

CI users may sometimes have problems with speech recognition when many people are speaking at once. A previous study found that lower frequency hearing enhances sound recognition. This study examined these issues and found that the lower frequency cues combined with the differences in the rate of stimulation improved noise perception.

Two new measurement methods were developed for this study and will enhance further CI research. The first method allows a CI to record and measure 'electroencephalographic' (EEG) activity. The second separates the EEG signal from the CI. This allows audiologists to assess a user's speech perception with much greater ease and accuracy.

The new technology means that it may be possible to develop a closed-loop CI instead of the currently used open loop. This device could automatically measure neural response and optimise stimulation accordingly.

Project research has provided new insights into the mechanisms that allow CI users to understand speech more clearly. The findings will greatly improve the treatment for these people.

LFAA

- ★ Coordinated by Trinity College in Ireland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151728>



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PATHOGENESIS OF FOOD POISONING

Salmonella enterica is a major threat to human health and is a highly versatile pathogen that can infect many animals. European research is finding out the key to its survival success.

Salmonella enterica is responsible for global pandemic foodborne infections. Not only that, but it can also cause systemic and invasive infections with a high mortality rate. Due to the massive diversity of more than 2600 serovars within this species, many can live in the intestines of livestock and contaminate the food chain. Salmonellosis is therefore associated with animal products and produce, such as eggs and poultry meat.

The EU-funded ROLE OF SPIS (The role of Salmonella pathogenicity islands in salmonellosis outbreaks and invasive disease) project has investigated the impact of genetic variation on different serovars of Salmonella. The team led by Dr Ohad Gal-Mor looked specifically at the distribution of variable virulence factors among Salmonella serovars and the role they play in disease.

Fuelling the evolution of the different serotypes is the ability to acquire new genetic elements in their genome. Many of the virulence factors lie on mobile elements free for transfer. Key characteristics that may be passed horizontally include new metabolic pathways, general fitness and microbial resistance, significantly contributing to being a successful pathogen in different ecological niches.

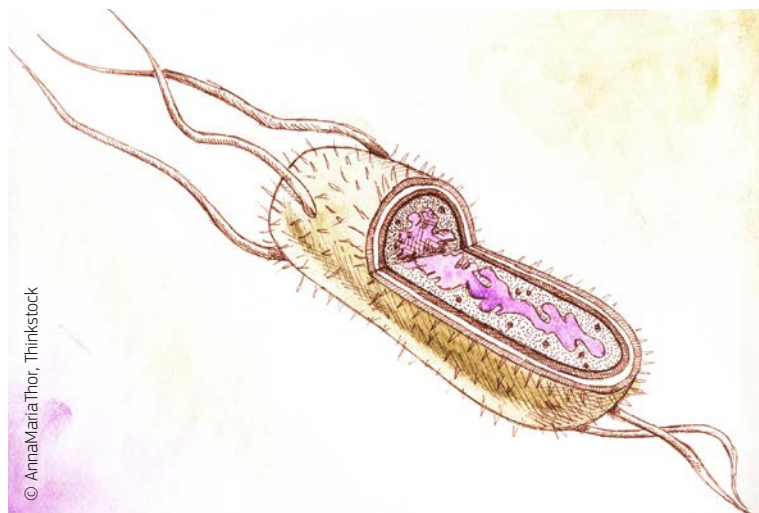
ROLE OF SPIS looked at factors particularly important to human health. Researchers focused on genotypic and phenotypic characteristics in relation to Salmonella causing invasive diseases. Using Israel as a case study, the project investigated an outbreak and the emergence of a new *Salmonella Infantis* strain and analysed this emergence from the evolutionary and molecular points of view.

Worryingly, this new serovar is showing complex multi-drug resistance and horizontal acquisition of various virulence factors.

Many scientific journals have covered the research of ROLE OF SPIS, and its results have featured in international conferences. Information on molecular pathways of microbes with devastating effects in pandemics could form the basis of new therapies in readiness for an outbreak.

ROLE OF SPIS

- ★ Coordinated by the Sheba Medical Center in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151717>



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"The self-assessment toolkit is available to 39 projects, and so far, half have completed at least one assessment cycle."



SOCIAL SCIENCES AND HUMANITIES

MAXICULTURE BOOSTS INITIATIVES IN DIGITAL CULTURE

Digital technologies provide a unique opportunity to preserve, access and spread our cultural heritage. But what are their socio-economic and technological impacts? A recent project has developed a toolkit for measuring projects' socio-economic and technological impact and how they can best use ICT in the cultural heritage domain.

Recent scientific projects in the digital culture domain digitise cultural heritage, making it accessible to many in creative ways, at the same time preserving its content. However, often, the results are not exploited to their full potential. The EU-funded project MAXICULTURE (MAXimising the Impact of CULTUral REsearch projects) offers two tools to help them: one is an assessment tool, the other a community platform.

'Digital cultural heritage is a large domain,' says George Ioannidis,

director of IN2, the company behind the technology for the MAXICULTURE community platform and project partner. Activities include scanning books, developing tools for digital storytelling and for accessing collections of multimedia documents, supporting collaboration in museums and libraries, and so on.

'Working with partners across the EU has been very useful for getting a clearer picture of this large domain,' explains Mr Ioannidis. The international partners (Eurokleis, T6, VDJ and

IN2) got in touch with European experts in digital cultural heritage who helped to shape the assessment tool and improve the community platform.

Giving people a clear idea of how effective their project is

The self-assessment toolkit is available to 39 projects, some of which can be read about on this site. So far, half have completed at least one assessment cycle. The projects can choose what to evaluate, for example their

technological, economic or social impact. They complete an in-depth questionnaire and get back an assessment report which calculates a performance score.

This can be compared against the average result of other projects and allows progress to be monitored over time. From this report, projects can then see what they need to do to improve their scores and devise a plan to achieve their target results.

EU cultural heritage projects tell their story

MAXICULTURE, which drew to a close at the end of 2014 and was backed by EUR 600 000 of EU funding, also offers a community platform which automatically creates collections of posts from information projects published on social media, along with articles, audiovisual files and photos that they can upload to their website.

'So far, 20 000 items have been compiled,' explains Mr Ioannidis, adding 'collections are put together attractively, giving the user the chance to

browse all the relevant posts and uploads in just one place.'

EC-funded projects gain a targeted platform for showcasing their results. Projects looking for partners can see who is relevant to them, while policy makers, museums, libraries and archive units can gain insight into what is working. The tool can also be used by investors to find the latest innovations in digital culture.

Building up engaging event resources

'The community platform also includes posts from events that the EC-funded projects attend,' says Mr Ioannidis, adding 'so in MAXICULTURE we also experimented with how we can create engaging stories about what happens at events.'

Building on these ideas, the STOM and mymeedia projects now aggregate social media posts surrounding an event, along with visual material (photos, videos), presentations and keynotes. This is built up into an event resource which organisers can use, for

example, to present the best moments from a conference.

For ICT Proposers Day 2014 in Florence, Italy, mymeedia made a digital stage available. It featured a social media stream and highlights of the event. Over 3 000 posts from social media networks and event presentations were collected. The stage was visited over 600 times during the two-day event.

MAXICULTURE

- ★ Coordinated by Eurokleis s.r.l. in Italy.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/result/rcn/155380>
- ★ Project website: <http://www.maxiculture.eu/>
- ★  <http://bit.ly/1AiidwY>

A NEW VIEW OF REALITY IN ANCIENT THOUGHT

A new look at two ancient Greek philosophical schools and thinkers offers insight on metaphysical indeterminacy.

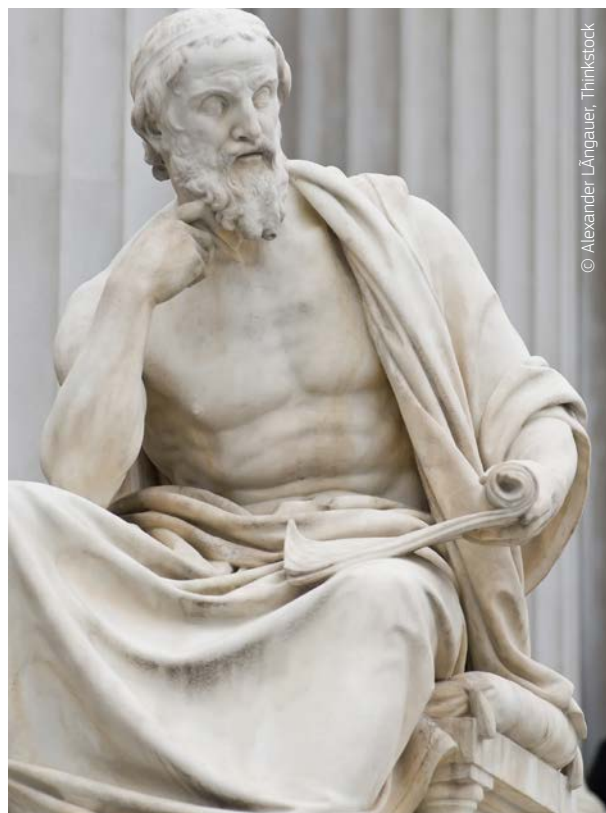
The fifth to the end of the fourth century BC was a crucial period in philosophical thought. Yet, modern traditional scholarship has overlooked the importance of the philosophers Protagoras and Pyrrho as well as the Socratic schools of the Cyrenaics and the Megarians. Protagoras (490–420 BC) was a pre-Socratic Greek philosopher and one of the Sophists. Pyrrho (360–270 BC) was a Greek philosopher of classical antiquity and is known as being the founder of the school of scepticism.

The EU-funded IAGPH (Indeterminacy and Argument in Greek Philosophy: An Alternative Metaphysics in Protagoras, Pyrrho and in the Socratic Schools) project worked to

"As a result of these efforts, major works and information have been generated and are available to the public."

uncover their importance in the realm of metaphysical indeterminacy. This is the notion that reality has no ontological structure, so that things are without any intrinsic essence on their

own. The research aimed to reconstruct the logic of indeterminacy in the context of these philosophers and schools of thought. Beyond that, it proposed that these figures and schools provided a metaphysical model of reality that was philosophically appealing. Thus, they offered an alternative to the Platonic/Aristotelian view of reality.



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Part of the reason their importance has been overlooked thus far is because the evidence is fragmented. Therefore, a significant part of the project involved a full historical and philosophical assessment of the theoretical contribution of both the schools and the philosophers. This included examining ancient philological texts as well as philosophical ones.

As a result of these efforts, major works and information have been generated and are available to the public. These include two books and an edited collection on the Socratics.

The project also hosted an international conference on the Socratic schools.

IAGPH

- ★ Coordinated by the University of Pisa in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151641>

AFRICAN REPRESSION AND PROTEST

An EU group has recently undertaken a study into political protest in Sub-Saharan Africa (SSA). The work revealed some interesting conclusions about protest organisation generally, including that the stronger the repression the less organised protesters will be.

According to international indices, the SSA countries of Nigeria and Zimbabwe are both classified as repressive. Studying those regions reveals general principles about protest in authoritarian situations.

The EU-funded project PROAFRI (Protests in Sub-Saharan African countries) studied political mobilisation in the target countries between 1995 and 2010. In addition, the study examined the effects of a repressive political context on organisational structures sustaining resistance mobilisation. The source of information was existing surveys of public opinion, which reflect individual engagement in demonstrations. The two-year study concluded in August 2014.

Investigations underlined that repression can either defuse or trigger development of an organisational structure. While a moderate level of repression may trigger mobilisation, a greater military capacity combined with strict repression will deter and defuse mobilisation. Research also revealed that where protesters can rely on a strong organisational structure, including networks with affiliate organisations, high rates of mobilisation result.

Lastly, the work identified three conditions where organisations find alternative means of action, and thus maintain a stable organisation structure amid authoritarianism. The conditions include: violence, transnationalisation and a moderation of action options. Protest effort depends on the strength of protest organisations, and on the extent of international alliances.



“PROAFRI succeeded in clarifying the means by which protest organisations survive in repressive contexts.”

PROAFRI succeeded in clarifying the means by which protest organisations survive in repressive contexts. In addition, the research showed that when repression is cohesive across all arms of government, political challengers face minimal opportunities.

PROAFRI

- ★ Coordinated by the University of Geneva in Switzerland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151685>

TRIBAL LOYALTIES IN POLITICAL STRUGGLES

Eight sub-tribes make up the Khawlan b. Amir tribal confederation, a society divided by political power struggles in south-western Arabia. An EU-funded research initiative explored new tribal loyalties and alliances arising within Khawlan tribes following the Huthi conflict.

Between 2004 and 2010, six so-called wars took place in Yemen. Termed the Huthi conflict, the clash between the government, political and sectarian contenders escalated into a large-scale insurrection due to tribal involvement.

The project **SHIFTING LOYALTIES** (Shifting loyalties: The tribes of Khawlan b. Amir in the Huthi conflict in north-west Yemen) retraced the development of tribal loyalties and allegiances during the conflict. It brought to light the factors affecting tribal involvement and loyalties as well as impact on the course and outcome of the conflict.

A combined methodological approach allowed **SHIFTING LOYALTIES** to gather unique empirical knowledge regarding the particular intricacies of the Huthi conflict. The study involved ethnographic fieldwork, which was supplemented with ongoing online exchanges with human sources and informants due to Yemen's unstable security situation. Qualitative content analysis, on the other hand, allowed the examination of written source materials. These included Western and especially Arabic scientific literature as well as Yemeni and Saudi online journals and newspapers.

Findings show that in the governorate of Sa'dah, local society is still dominated by tribal customs and traditions. Selective favouritism towards certain tribal leaders and the segregation of others led to rivalries and conflicts among

local tribal elites. This resulted in social discontent and unrest as inequalities in influence, wealth and income became more pronounced. Research also found that in many cases the Huthi conflict was used to pursue pre-existing rivalries and feuds rather than defend religious or ideological objectives.

Beyond contributing new knowledge to a region of increasing international importance, project findings also enriched the field of social anthropology. The scientific framework developed enables the use of various approaches for researching the role of locals in implementation of policies, ideologies and religious interpretations.

SHIFTING LOYALTIES also advanced recommendations for organisations with a special interest in better understanding Yemeni conflicts and social disparities. These include (foreign) policy, security and international organisations dedicated to, for example, human aid and international development.

SHIFTING LOYALTIES

- ★ Coordinated by the Austrian Academy of Sciences in Austria.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151676>

*"A combined methodological approach allowed **SHIFTING LOYALTIES** to gather unique empirical knowledge regarding the particular intricacies of the Huthi conflict."*





"The ENTRA prototype is being tested on three typical energy-hungry components: real-time audio processing, robot and motor control, and real-time networking."

ENERGY AND TRANSPORT

BETTER SOFTWARE CUTS COMPUTER ENERGY USE

An EU research project is developing tools to help software engineers create energy-efficient code, which could reduce electricity consumption at data centres by up to 50 % and improve battery life in smart devices.

Until now, the target for energy savings by computers has been the hardware. But hardware is only part of the story, perhaps even the smaller part, as a new EU project is showing. Even with energy-efficient hardware, much of the potential for energy savings is wasted by the drain that inefficient software places on systems.

The EU-funded ENTRA (Whole-Systems Energy Transparency) project, which runs until September 2015, has come up with an experimental software prototype based on programming semantics that tells programmers how much energy will be consumed as a result of the code they are writing. The ENTRA tool runs alongside the program and, through code analysis and energy modelling, shows how much the code is going to cost the computer in terms of energy use, and what the impact of design decisions on energy use will be.

'Compare it to the fuel efficiency of a car,' said ENTRA coordinator Professor John Gallagher, of Roskilde

University in Denmark. 'We think of that being the property of the car. You buy a car and it is supposed to consume 8 litres per 100 km or whatever, but of course that depends on the way you drive it. The same is true for computing. You think of energy being associated with the hardware, but it seems that potentially more energy can be saved at the software level with the same hardware, rather than putting a lot of effort into developing more energy-efficient hardware. That's where the ENTRA project comes in.'

Energy use visible to programmer

The ENTRA project focuses on energy efficiency as a design goal and aims to bring energy-efficient products of IT companies — quicker to market. The ENTRA tool shows energy use in terms of Watts (power consumption) or in absolute energy requirements (the energy needed to finish the task) depending on the speed of the processor (GHz). Rather than having to

wait until the program is installed and running on a machine and then measuring its energy (often too late to do anything about it), the programmer gets an early picture from the energy predictions in the code.

The energy consumption of computers has become a major concern, both environmentally in terms of carbon footprint, and practically through the need for greater battery life. The huge growth in cloud computing over the past decade has meant data centres have become very large consumers of energy. Power is needed not just for cooling, but also to process and transport data. The ENTRA approach can help both with the programming and with scheduling of tasks to minimise energy.

Big savings achievable for smartphone batteries

As the demand for computing power increases exponentially, software applications will need to be designed in an energy-efficient way to allow smaller batteries to be charged less frequently.

With an eye on meeting these challenges, the ENTRA prototype is being tested on three typical energy-hungry components: real-time audio processing, robot and motor control, and real-time networking. The software defining them is being run on hardware at XMOS, a semiconductor company in Bristol, the United Kingdom, which produces for the automotive, computing and games industries. Researchers in the project are seeing in these case studies that energy savings could be at least 20–50%, e.g. by

compacting programs, and optimising timing of operations to permit lower processor speeds.

XMOS plans to add ENTRA components for energy optimisation into its tool-chain. The ENTRA results are also being exposed to internationally leading companies such as ARM and ST Microelectronics, and world leading academics in energy-efficient computing at the 'Energy Aware Computing' (EACO) workshops.

Scaling up ENTRA's results to system level is feasible, said Professor Gallagher. 'The whole approach is independent of any particular hardware or application domain in the sense that it is based purely on the programming language semantics and a general energy model. So we could apply the same techniques to high performance computers,' he pointed out.

The ENTRA project is receiving FP7 funding of EUR 2.1 million. Beginning in October 2012 and ending on 30 September 2015, the project consists of four partners in Denmark, the UK and Spain.

ENTRA

- ★ Coordinated by Roskilde University in Denmark.
 - ★ Funded under FP7-ICT.
 - ★ <http://cordis.europa.eu/result/rcn/153150>
 - ★ Project website: <http://entraproject.eu/>
-

NEW SOFTWARE SOLUTIONS FOR STREAMLINING MARITIME OPERATIONS

EU researchers have developed new reporting software to help Europe's maritime transport sector achieve cost and time efficiencies.

A new software application designed to make reporting obligations for shipping operators simpler and more cost effective has been developed through the FP7-funded EMAR (e-Maritime Strategic Framework and Simulation based Validation) project. The new system, called i-Ship, connects vessels, operators and reporting authorities together in a collaborative

web-based reporting system that offers greater clarity and speed.

The system achieves this by providing a single link for shipping companies to submit their reporting formalities. i-Ship is fully compliant with EU administrative procedural laws, and also offers users a range of advanced reporting features including easy pre-loading and notifications.

Other benefits include complete systems integration and customisation, along with visibility of the reporting and compliance status of any given fleet.

This new application is one example of how the EMAR project, scheduled for completion at the end of 2014, aims to make European maritime transport more secure and more competitive. Maritime transport is a major economic engine, facilitating international and interregional trade and ensuring the security of supply of energy, food and commodities.

In fact, almost 90% of the EU's external freight trade is seaborne, while each year more than 400 million passengers embark and disembark at European ports. Over the next 10 years a substantial increase in both international and intra-EU seaborne trade is expected.



One of the key challenges facing this busy sector is the sheer complexity of navigating not only the seas, but also

“i-Ship software is one example of how the EMAR project aims to make European maritime transport more secure and more competitive.”

the necessary legal obligations imposed on operators and vessels. The overall goal of the EMAR project is therefore to support the development of European capabilities, strategies and policies that facilitate an efficient and sustainable waterborne transport system.

The i-Ship software tool is one example of this. The EU believes that the next generation of e-Maritime

infrastructure needs to provide not only technological services — including connectivity and security — but also shared information and knowledge, in order to better manage collaboration between public and private parties.

In recognising the critical role of ICT for productivity and innovation — and in anticipating a new era of e-business solutions based on integrated ICT systems and tools — the EMAR project is key to the achievement of the strategic goals of the EU Maritime Transport Strategy 2018.

This strategy identifies the ability of the maritime transport sector to provide cost-efficient maritime transport services as critical. Furthermore, the long-term competitiveness of the EU shipping sector will help to generate value and employment in the EU, both directly and indirectly.

The EMAR project, which has received EUR 3.7 million in EU funding, is also closely aligned with the objectives of the TEN-T programme, which aims to develop an efficient ‘trans-European transport network’ (TEN-T).

The TEN-T programme is the main instrument for EU financing of transport infrastructure developments, including Motorways of the Sea, which rely on advanced ICT integration technologies. TEN-T can therefore be seen as an important route towards the actual application of solutions developed through the EMAR project.

EMAR

- ★ Coordinated by BMT Group Limited in the United Kingdom.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/news/rcn/122201>
- ★ Project website: <http://www.emarproject.eu/>
- ★  <http://bit.ly/1zMN9pD>

HELICOPTER-STEERING INNOVATION COULD HERALD NEW ERA FOR AERIAL TRANSPORT

EU-funded researchers are behind a new helicopter-steering mechanism that could open the door to ‘flying cars’ and decrease traffic congestion.

For decades, flying cars have featured in our visions of what futuristic cities might look like. Now, researchers with the EU-funded MYCOPTER (Enabling technologies for personal air transport systems) project have developed a steering system that makes helicopters as easy to control as cars. While having your own ‘Personal aerial vehicle’ (PAV) may still be some way off, the success of the project opens up the possibility that one day flying vehicles could indeed be an integral part of the urban transportation network.

Currently, only pilots who have undergone extensive training can fly a helicopter. Four control axes must be operated in order to maintain a stable position in the air. This requires skill, knowledge and concentration. In order to extend aerial flying to the general public, PAV operation needs to be significantly simplified, with a greater degree of automation introduced.

The MYCOPTER project started in 2011 with the objective of developing a PAV ideally designed for travelling between the home and the workplace. The project envisioned that the vehicle would fly at a low altitude in urban environments, be fully or partially autonomous without requiring ground-based air traffic control and operate outside controlled airspace. Current air traffic would therefore remain unchanged, ensuring that PAVs could be easily integrated into the next generation of controlled airspace.

To achieve this, the project replaced the helicopter’s cyclic stick, which is responsible for movements around the longitudinal and transverse axis, with a steering wheel. Pilots



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simply need to turn the wheel in the intended direction. The MYCOPTER team believes that this represents an important step in making PAVs more accessible to the general public.

Test models were implemented on unmanned aerial vehicles, motion simulators and a manned helicopter. The project also focused on collision avoidance systems, pilot training and overall streamlining of helicopter control processes. New automation technologies for obstacle avoidance, path planning and formation flying were developed and successfully tested. The MYCOPTER project sought to

“The project replaced the helicopter’s cyclic stick with a steering wheel. Pilots simply need to turn the wheel in the intended direction.”

assess how the benefits of automation could be implemented while still providing the pilot with the ability to feel in control.

The success of the MYCOPTER project suggests that the eventual implementation of a ‘Personal aerial transportation system’ (PATs) could be feasible. Such a system would have a beneficial impact on citizens’ daily lives by helping to resolve issues related to traffic congestion and even environmental pollution.

For example, an aerial transportation network would enable commuters to avoid sitting in traffic queues and instead travel directly between two points. Travelling directly point

to point could also save on fuel and help to reduce the stop and go traffic that wastes large amounts of energy.

Outside of this particular project, new battery operated aerial vehicles are currently being developed and could provide further environmental improvements. Less road congestion might also lead to cost savings in terms of road maintenance and associated support structures.

The results of the project, due for completion at the end of 2014, were recently demonstrated and discussed at the German Aerospace Centre (DLR) in Braunschweig, Germany on November 20, 2014.

MYCOPTER

- ★ Coordinated by the Max Planck Society for the Advancement of Science in Germany.
- ★ Funded under FP7-TRANSPORT.
- ★ <http://cordis.europa.eu/news/rcn/122193>
- ★ Project website: <http://www.mycopter.eu/>
- ★  <http://bit.ly/1DFFiYo>

SWITCHING TO ENERGY-EFFICIENT ELECTRICAL APPLIANCES

EU-funded researchers have developed an online software platform to help household appliance designers make their products more energy efficient.

Integrating environmental considerations into household products and appliances requires strategic thinking at every stage of design, attendees at a recent webinar heard. Organised by the EU-funded G.EN.ESI (Integrated software platform for Green Engineering dESIgn and product sustainability) project, the webinar presented new ways of supporting the development of commercially viable, cost-effective products with significantly reduced environmental impact.

This, ultimately, has been the key aim of the G.EN.ESI project. Due for completion at the end of January 2015, the project has developed a software engineering platform to boost the eco-design and product sustainability of electronic and mechatronic products. Here, manufacturers can find tools to help them evaluate technical solutions during early design stages, and assess their impact on the whole product life cycle.

Energy consumption has become a key consideration for product manufacturers. The residential/domestic sector makes up about 20% of global energy consumption, with greenhouse gas emissions from the sector exceeding 35%. Household appliances contribute greatly to this energy consumption.

This is why the EU recently took action to reduce energy consumption in the home. At the beginning of this year, new energy-efficiency measures came into force, with the Commission estimating that they will save the same amount of energy currently consumed by 11 million homes a year, and save consumers EUR 45 per household in energy bills. These

measures include energy labels for cooking appliances and products sold online, and automatic standby requirements for connected devices and coffee machines.

“The project’s software platform helps product designers make ecological design choices without losing sight of cost.”

The G.EN.ESI project therefore addresses a real manufacturing need. Appliance manufacturers must consider ecological aspects when designing new products, while at the same time remaining cost competitive. The project estimates that early design decisions — during the conceptual phase for example — influence between 70 and 80% of the total product cost, so it is clearly vital that all decisions taken are informed decisions.

However, while advanced software tools already exist to support designers in their functional, structural and aesthetical choices, no easy-to-use tools exist for the environmental evaluation. The project’s software platform addresses this



gap, by helping product designers make ecological design choices without losing sight of cost.

Furthermore, the platform can be completely integrated with other design and development tools, such as CAD for example. While the proposed approach is targeted primarily at the household appliance field, it can be easily extended to other mechatronic products. The project has also contributed to international

eco-design standards by suggesting rules and guidelines to manage the design process of eco-sustainable products.

The webinar, held on 12 January 2015, was attended by around 30 academics and industrialists. The event began with an introduction to the G.EN.ESI project, followed by a demonstration of the software tools currently being developed. The webinar concluded with a question and

answer session led by Helen Cornwell from the University of Bath, a key partner in the G.EN.ESI project.

G.EN.ESI

- ★ Coordinated by Marche Polytechnic University in Italy.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/news/rcn/122266>
- ★ Project website: <http://genesi-fp7.eu/>
- ★  <http://bit.ly/16a8snc>

WING TIPS THAT DEFORM ON DEMAND

Despite major advances in engine design, aircraft configurations have remained relatively the same over the last 50 years. Now, a novel morphing wing concept has demonstrated the potential to reduce drag and thus fuel consumption and emissions.



Even small changes in drag can have a major influence on the air transport industry's environmental impact given the high volume of traffic. Winglets (small wings on the tip of wings) have been around for a while. Scientists are now re-inventing them to be adaptive, changing their shape via an actuator system to achieve optimal shape throughout each flight.

EU-funded researchers recently developed a novel morphing winglet concept within the context of the project CLARET (Control and alleviation of loads in advanced regional turbo fan configurations).

Using mathematical models, scientists determined the appropriate trade-off between aerodynamic performance and system weight and investigated performance characteristics. The team then defined the range of wing-tip parameters to be studied. Investigators also determined that two separate systems would be required to achieve all required winglet shapes; an off-the-shelf actuator was chosen.

Researchers employed an advanced aeroelastic finite element model to determine the system's response under a variety of static and dynamic gust loads. Outcomes led

scientists to stiffen some parts of the wing tip for better performance.

Device inclusion increased range by up to 5 % and decreased gust load between 2 and 4 % with changes in the morphing winglet shape. Thus, this two-year project provided evidence supporting the use of the morphing winglet concept to enhance aircraft performance while reducing the environmental impact of flight.

Eventual commercialisation of the concepts will aid the EU in achieving ambitious goals for the greening of air transport. In parallel, the advanced technology will boost the competitive position of the EU aircraft manufacturing industry.

CLARET

- ★ Coordinated by the University of Bristol in the United Kingdom.
- ★ Funded under FP7-JTI.
- ★ <http://cordis.europa.eu/result/rcn/151698>
- ★ Project website: <http://www.bris.ac.uk/aerodynamics-research/claret/>
- ★  <http://bit.ly/1AiTLf9>

TURNING OLIVE OIL WASTE INTO ENERGY TO BENEFIT RURAL ECONOMIES

EU-funded researchers are converting olive oil waste into heat and electricity to facilitate cost-effective and sustainable agricultural production.



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“A three-part subsystem was developed, the primary step being an anaerobic digestion reaction to produce biogas from the waste.”

A pilot plant capable of converting toxic olive oil waste into heat and electricity has been built at an olive farm in Andalusia. The facility, constructed through the EU-funded BIOGAS2PEM-FC (Biogas Reforming and Valorisation through PEM Fuel Cells) project, was completed in November 2014 and promises to provide economic and environmental benefits to a predominantly agricultural and industrially underdeveloped region of Spain.

Olive oil is crucial to the region's economy. Spain produces 50% of the world's olive oil, with 73% of that coming from Andalusia. In 2013, olive oil exports from Andalusia alone were worth EUR 1.5 billion. Spain also recently overtook Italy as the market leader in olive oil in the US and Japan. Meeting worldwide demand — while at the same time achieving sustainable production — is vital.

Indeed, the most important issue that the BIOGAS2PEM-FC project addressed was how to deal with the environmentally harmful and costly disposal of olive oil waste. This waste contains pesticides and toxic organic compounds; it is acidic and has a high level of salinity. While waste has conventionally been turned to landfill, this is not a sustainable solution in the long term.

The BIOGAS2PEM-FC project therefore sought to develop innovative technology to convert waste from olive oil production into electricity. A three-part subsystem was developed, the primary step being an anaerobic digestion reaction to produce biogas from the waste. This process, which involves microorganisms breaking down biodegradable material in the absence of oxygen, is often used to manage waste and to produce fuels. Anaerobic digestion has become an attractive method for dealing with solid waste treatment, because the process enables excellent waste stabilisation and energy recovery without any pre-treatment of the residue.

The second step involved converting this biogas into a hydrogen-rich gas, which in the final phase could be turned into electricity through the use of fuel cells. These convert chemical energy from fuel into electricity through a chemical reaction with oxygen or another oxidising agent.

The three stages have now been brought together to create a complete waste processing plant to generate heat and electricity that can then be used by the olive mill.

Researchers behind the project, which received EUR 1.1 million in EU funding

from the FP7 programme, are confident that the innovation will have a positive impact on olive oil production. It is estimated that an average olive oil plant produces up to 30 million cubic metres of wastewater during the intense annual three to four-month production period. This is wastewater that could be used to produce biogas.

A final project meeting was held in Malaga in October 2014 to review the achievements and to visit the pilot plant itself. The end result is a modular, reliable, cost-effective and efficient 'Combined heat & power' (CHP) system suitable for distributed, on-site power generation from agricultural waste. Furthermore, the technology could be applied to other forms of agricultural waste, which would open up an array of potential commercial opportunities.

BIOGAS2PEM-FC

- ★ Coordinated by Powercell Sweden AB in Sweden.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/news/rcn/122198>
- ★ Project website: <http://www.biogas2pemfc.eu/>
- ★  <http://bit.ly/1D5vtVJ>

ENVIRONMENT AND SOCIETY

UNDERSTANDING CLIMATE CHANGE IMPACT ON AMAZON DEFORESTATION

EU-funded researchers have assessed the impact of climate and land-use change on deforestation in the Amazon and put forward policy recommendations designed to ensure the long-term sustainability of this vast ecosystem.

Supporting local efforts in South America's Amazon Basin is the most effective way for the EU to reduce regional deforestation, along with strengthening environmental trade standards at the global level. These are some of the key recommendations to come out of the EU-funded AMAZALERT (Raising the alert about critical feedbacks between climate and long-term land use change in the Amazon) project, which was completed in November 2014.

'Amazon forests are of crucial importance,' explains project coordinator Bart Kruijt of Stichting Dienst Landbouwkundig Onderzoek in the Netherlands. 'They safeguard regional water recycling and carbon storage. If current Brazilian policies for Amazonia are maintained and enforced, deforestation rates may be kept low, but if global markets for forest-related products and services grow and regional institutions become weak, 50% of the Amazon could be deforested by 2100.'

Understanding the threat

One reason why scientists have been unable to accurately predict the rate of future deforestation is that the

threat posed by climate change is so complex. AMAZALERT, which brought together climate and land-use scientists from 14 European and South American institutions, has examined how global and regional climate and land-use changes will impact Amazonian forests, agriculture, waters and people.

'New evidence suggests that some tree species are especially sensitive to drought,' says Kruijt. 'In the worst case, up to 50% of forests could disappear or degrade, which would dry the regional climate.'

Studies also showed that forests in the south and southeast of the Amazon Basin are more vulnerable to drought than forests in the north and northwest.

Strong civil society and social cohesion were found to be important elements in preventing deforestation. While the impact of trade with the EU on Amazon deforestation was shown to be significant, this was limited when compared to the impact of trade with other regions. International investments in hydro-power and mining were also found to have an impact on the Amazon ecosystem.

Safeguarding for the future

The project's investigations into the impact of global and regional climate and land-use change have led to a number of policy and research recommendations.

'Spatial planning, formalising land tenure and ensuring effective law enforcement can help strengthen the buffering function of forests against climate change,' says Kruijt. 'Sustained long-term monitoring of the environmental conditions in the forest is also crucial for detecting the possible onset of instability in a timely manner.'

AMAZALERT has made good progress in developing an 'early warning system' to achieve this goal. The project also linked up with other international projects (such as the

EU-funded ROBIN project, due for completion in 2015) and supported regional efforts in South America to monitor

"AMAZALERT's solutions have attracted positive government-level interest in Brazil."

climate change impacts. AMAZALERT's solutions have also attracted positive government-level interest in Brazil.

For its part, the EU should support regional efforts to reduce deforestation, and work to strengthen environmental trade standards at the global level. This would enhance the

impact of countries and international organisations that have a greater influence on the Amazon. Boosting the demand for environment-friendly products from the region would also generate momentum towards an overall increase in environmental standards, says Kruijt.

AMAZALERT has also put forward future research recommendations, arguing that to fully understand the risk of Amazon forest degradation, scientists must focus on the interaction of various climate-related factors such as increases in CO₂, temperature increases and the prevalence of drought. Furthermore, basin-wide research should emphasise regional variability in vulnerability.

'The complexity of these interactions needs to be studied further, so as to better understand and model the dynamics of climate and land-use change,' concludes Kruijt.

AMAZALERT

- ★ Coordinated by Stichting Dienst Landbouwkundig Onderzoek (DLO) in the Netherlands.
- ★ Funded under FP7-ENVIRONMENT.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33596
- ★ Project website: <http://www.eu-amazalert.org/home>

IMPROVING DEFORESTATION MONITORING TOOLS

A coordinated research project between Australia, Europe and the United States has yielded new tools and models for estimating deforestation and forest degradation over time.

The volume of biophysical data from satellites has expanded massively in the last few years, and the demand for that data has increased. In particular, there is a need for improved deforestation data on a large spatial as well as temporal scale.

Funded by the EU, the STRUCCHANGE (Monitoring forest degradation using terrestrial lidar and satellite images) project contributed to improving the assessment of deforestation and

forest degradation. The project made use of recent advancements in laser technology and Earth observation techniques.

A ground-based laser scanner (known as lidar) was used to develop a new technique for measuring forest canopy structure. This provides more accurate information on forest biomass and other attributes.

Secondly, researchers developed a new modelling framework to study

the relationship between canopy attributes measured by lidar and satellite data. Together, this information was used successfully to assess deforestation.

However, researchers found that this method did not take seasonal canopy variation into account. Consequently, they built an algorithm called BFAST to incorporate seasonality into deforestation assessments. The results of this area of work are available on the project website.

STRUCCHANGE's work has been well received by the scientific community and has generated much international interest. In particular, Google is currently incorporating the project outcomes into a global forest disturbance monitoring tool on its Google Earth platform.

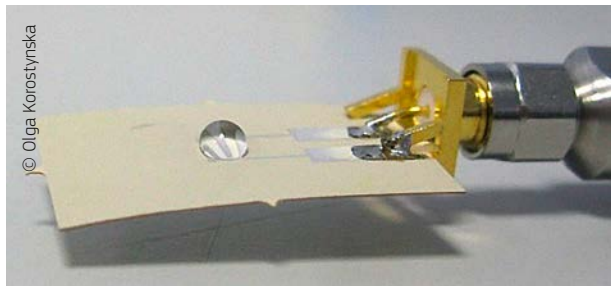


STRUCCHANGE

- ★ Coordinated by Wageningen University and Research Centre in the Netherlands.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151686>

REAL-TIME WASTEWATER MONITORING

Researchers have developed a prototype device that can monitor wastewater for specific contaminants, in real time.



Contamination of water sources is one of the major environmental problems of our time. EU legislation has been passed to address certain common contaminants (phosphorus, ammonia, fatty acids), but water quality monitoring is currently infrequent, insensitive and costly.

The EU-funded WATER-SPOTCHECK (Multi sensor fusion for real-time monitoring of waste water quality) project was set up to develop a multi-sensor monitoring device to address this problem. A number of different electromagnetic wave sensors were developed and tested for the device. The envisioned prototype could detect and measure the concentration of specific contaminants in wastewater in real time.

Researchers also developed and tested approaches to enable continuous monitoring. A laboratory-scale prototype was built and validated against an array of potential organic and inorganic pollutants as suggested by industry and specific end-user requests.

Once tested on a small scale, a bespoke prototype was designed and installed at a wastewater facility in the United Kingdom. The prototype was run in parallel to conventional water monitoring tools, and was demonstrated to be equally sensitive, without the 14-day processing period usually required.

WATER-SPOTCHECK demonstrated that real-time monitoring of contaminants in wastewater is a feasible and attainable goal. The project produced a number of scientific papers as well as several patents to cover commercialisation in the United Kingdom and the United States.

WATER-SPOTCHECK

★ Coordinated by Liverpool John Moores University in the United Kingdom.

★ Funded under FP7-PEOPLE.

★ <http://cordis.europa.eu/result/rcn/151713>

★ Project website:
<http://www.ljmu.ac.uk/BLT/BEST/RFM/121778.htm>

STREAMS CONTRIBUTE TO GLOBAL CARBON CYCLE

Scientists understand that streams play a key role through their contribution to the global carbon cycle; however, unanswered questions remain. These include how organic carbon, which is bound to an organic compound and protected in the soil over long periods, can be made available to organisms.

The EU-backed project PRIMA (Priming in an aquatic ecosystem — Stream biofilms as hotspots for carbon cycling) investigated the stream conditions that lead to microbial biofilms. Biofilms are created when microbial cells stick to one another on a surface, such as a stream bed.

PRIMA hypothesised that terrestrial organic carbon is subject to priming in stream microbial biofilms, which play an important role in aquatic ecosystems. Priming occurs when the addition of carbon or nitrogen affects the rate of decomposition occurring in biofilms. Material labelled with the stable carbon isotope ^{13}C was used to test for priming by tracking and quantifying carbon flux.



Results indicated that priming did not appear to occur in the hyporheic zone of the stream, where shallow groundwater mixes with surface water. However, priming does occur in biofilms, which coexist in close proximity to algae at the bottom of the stream. Material exuded from the algae can undergo change and may serve as the primer. In addition, the biofilm

metabolism and changes to dissolved organic carbon may contribute to the generation of 'recalcitrant' organic matter.

Two major experiments were conducted under the auspices of PRIMA. The first mimicked hyporheic biofilms in 25 bioreactors that contained different potential primers, including

exuded material from algae. The second experiment mimicked light-dependent, bottom-dwelling biofilms

“Work conducted by the PRIMA project provides further insights into the role of inland waters in global carbon cycling.”

grown under different light conditions. The aim was to provide different algae and, therefore, different potential primers.

Both experiments used willow (*Salix*) grown in a ‘carbon dioxide’ (CO_2)-enriched atmosphere, where the gas was labelled with ^{13}C . The result was fully labelled plant tissue that provided a complex mix of ^{13}C -labelled organic matter, which was decomposed to remove most of the functional groups.

The remaining material was described as recalcitrant and used in both experiments. This methodology enabled researchers to measure the fraction of respiratory CO_2 from the degradation of recalcitrant dissolved organic matter.

Work conducted by the PRIMA project provides further insights into the role of inland waters in global carbon cycling. The results confirm their importance as major sites of carbon cycling, which must be taken into consideration when investigating the mechanisms behind climate change.

PRIMA

- ★ Coordinated by the University of Vienna in Austria.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151647>

WHEN THE HEAT IS ON SPECIES SURVIVAL

Will global warming affect species survival? To answer this question, research has to look at the added effect of species interdependence.



Many species are dependent on temperature for other ecological niches, such as the reproductive or food niche, for example. Relationships between tightly co-evolved species may also be affected by thermal change.

Parasitism is perhaps the archetypal example of a co-evolved relationship. To investigate the effects of temperature change, the EU-funded COEVOLCLIM (How temperature affects co-evolutionary interactions between partners: a study on physiological underlying mechanisms) project looked at the grain aphid, *Sitobion avenae*, and its main parasitoid, *Aphidius rhopalosiphii*. The aphid pests feed on winter and spring cereals and the parasitoid wasp lays its eggs in the aphid where they develop.

COEVOLCLIM researchers looked at the effects of temperature at the pre-egg laying stage when behavioural effects come into play. At the post-egg deposition phase,

immunological interactions affect survival of both when the parasitoid is developing in the aphid.

Both behavioural and immunological interactions were disrupted by temperature, but warmer temperatures had a stronger effect on these interactions. At warmer temperatures, physiological responses such as metabolic rate and behavioural parasitoid attack rate affect the relationship. At lower temperatures, there is a reduction in the activity of both species. For immune interactions, aphid resistance increased with temperature.

“The research has provided insight into the possible effects of climate change on host-parasitoid relationships that can be applied to other species.”

The research has provided insight into the possible effects of climate change on host-parasitoid relationships that can be applied to other species. In particular, this would apply to ectotherms such as sea turtles whose body temperature relies primarily on the ambient temperature.

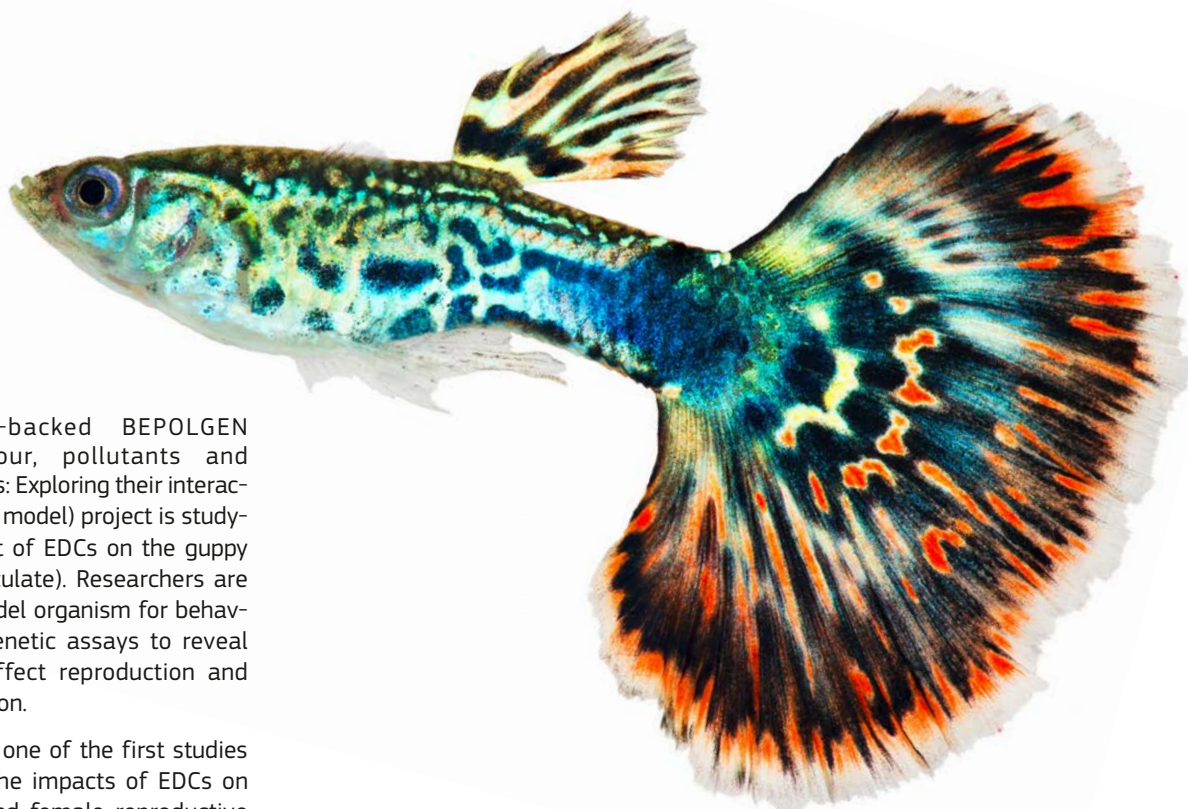
In a time of great change and where conservation is paramount, knowledge about the effects of climate change on plant and animal communities is crucial. Bio-control methods can also use information on species temperature relationships to improve pest regulation for hothouse crops.

COEVOLCLIM

- ★ Coordinated by the Institute for Environmental Studies, VU University Amsterdam (IVM-VU) in the Netherlands.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151640>

ENDOCRINE DISRUPTORS IN FISH MODELS

Aquatic habitats are exposed to 'Endocrine disrupting chemicals' (EDCs), which can affect the endocrine system of organisms, even at low levels. These chemicals can have a serious impact on reproduction, but their effect on evolutionary processes and population viability is not well understood.



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The EU-backed BEPOLGEN (Behaviour, pollutants and genomics: Exploring their interactions in a fish model) project is studying the effect of EDCs on the guppy (*Poecilia reticulata*). Researchers are using the model organism for behavioural and genetic assays to reveal how EDCs affect reproduction and sexual selection.

BEPOLGEN is one of the first studies to examine the impacts of EDCs on both male and female reproductive behaviour and quality of offspring.

Researchers used state-of-the-art 'Next-generation sequencing' (NGS) technology to investigate how EDCs alter gene expression. Guppies were exposed to synthetic oestrogen 17alpha-ethynyl estradiol (EE2), which is used in oral contraceptive pills. The purpose was to determine how it affects reproductive behaviour and reproductive success.

The project used NGS to determine transcriptomic profiles of the fish's brains and ovaries or testes. It also investigated the effects of exposure to EE2 on gene expression.

In addition, BEPOLGEN has examined the identity of and changes to expressed transcripts (sequences of RNA molecules produced by transcription). The aim is to determine if there is a link with observed behavioural changes.

Information gained from the study will enhance understanding of genetics, including how organisms adapt to environmental changes brought about by human activities. Therefore, the project outcomes will provide evidence of how the genome and environment interact.

This evidence will include identification of genes that differ in expression between males and females and changes in expression due to EE2. Furthermore, changes in gene expression due to EE2 exposure will be compared with its effects on sexual selection.

Potentially serious effects of EDCs on humans (such as decreasing sperm counts) and wildlife mean their long-term effects must be studied in greater detail. As such, the knowledge gained from BEPOLGEN will help to ensure a safe and sustainable European environment.

"Information gained from the study will enhance understanding of genetics, including how organisms adapt to environmental changes brought about by human activities."

BEPOLGEN

- ★ Coordinated by Glasgow Caledonian University in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151694>



INDUSTRIAL TECHNOLOGIES

3D VISUALISATION OF THE INTERNET OF THINGS

The Finnish start-up CyberLightning has used FI-WARE, a set of online services for developers, to create a new software platform called CyberVille®. This 3D visualisation tool can monitor Internet of Things networks such as Smart Grids and Smart City infrastructures.

The EU-backed FI-WARE (Open APIs for Open Minds) project is the core component of the Future Internet Public-Private Partnership. It supports hundreds of developers and their companies in implementing innovative ideas. 'Thanks to our involvement with FI-WARE, and by developing core components and applications with FI-WARE technology, today we are recognised as the leading industrial internet company in Finland,' explains Ville Mickelsson, CEO of CyberLightning, a spin-off from the University of Oulu. 'The EU funding enabled us to build a team to work on the project and these people have stayed with us to take the company forward.'

CyberLightning is now a company making headway with its pioneering 3D visualisation techniques

connecting the industrial Internet of Things — and has created 14 full-time jobs in the process.

Visualising the industrial Internet of Things

The CyberVille® software platform is based on FI-WARE and was launched in May this year. It combines data collection and big data processing with 3D modelling in a powerful platform to monitor and control industrial networks made up of the Internet of Things (IoT). These include energy networks (smart grids) and smart city infrastructure.

The resulting visualisation tool, based on 'Geographic information system' (GIS) data sets and real-time data feeds from IoT sensors, provides companies and organisations with a strategic tool. It enables the company's corporate customers to control sensor and machine networks using a simple point-and-tap interface on any mobile device.

CyberVille's core engine is the CyberVille™ Mind which collects and elaborates big data and prepares data representation in 3D for the user interface (Cyberville™ UI), which

displays in all types of tablet and smartphone browsers.

Applications in the energy and property sectors

To demonstrate its energy applications, CyberLightning has built a 3D model of an operating wind farm, with sample data sets reporting on the status of individual wind turbines and control points in the system. Viewed on a tablet, the visualisation is so richly detailed that different rotation speeds of fan blades can be seen.

In a smart city application such as facility management, GIS data is merged with 'Computer aided design' (CAD) models of a building and its internal smart networks, such as lighting, air conditioning control, occupancy sensors, and security. On a city-wide scale, visualisation of intelligent street lighting, or the operation of public transit systems based on real-time data, will benefit operations, maintenance and customer service.

Two of CyberLightning's major customers are the Finnish electric utility Fortum and the state real estate company, Senate Properties, both of which are already using CyberVille to develop

"With CyberVille, we are presenting the first solution addressing the challenges of systems management in incredibly complex network environments."

their IoT smart grid and real estate interfaces. CyberLightning is also talking to industrial 'Original equipment manufacturers' (OEMs), system integrators and other companies in the energy sector about implementing its solutions.

'Network operations and control rooms for infrastructure systems today are typically populated with dozens of displays. It's a major challenge for skilled staff and managers alike to view the big picture,' said Ville.

'The complexity of these types of networks will grow exponentially in the Internet of Things era. With CyberVille, we are presenting the first solution addressing the challenges of systems management in incredibly complex network environments,' he added.

CyberLightning received EUR 1 million of funding from FI-WARE from April 2013 to September 2014. FI-WARE's third funding phase was launched in September 2014 with a budget of more than EUR 100 million, 80 million

of which is destined for SMEs and entrepreneurs.

FI-WARE

- ★ Coordinated by Telefonica Research and Development SA in Spain.
- ★ Funded under FP7-ICT.
- ★ <http://cordis.europa.eu/result/rcn/153911>
- ★ Project website: <http://www.fiware.org/>
- ★ <http://bit.ly/1r84ldL>

SAFEGUARDING CITIZENS WHILE RESPECTING THEIR RIGHT TO PRIVACY

Using innovative new technology, EU-funded researchers have reconciled the need for robust surveillance with the right to privacy.

A technological surveillance solution designed to keep law abiding citizens safe while at the same time respecting their privacy has been developed by EU-funded researchers. The team of scientists behind the MOSAIC (Multi-Modal Situation Assessment & Analytics Platform) project, which recently announced its key outcomes, is now considering further research and commercial collaborations based on their achievements.

The results of the project come at a time when there is growing public debate over the extent to which surveillance is justified, and how the right balance between civil protection and personal privacy can be achieved. By developing smarter surveillance technologies capable of automated detection, recognition and mapping, the MOSAIC project — which was completed at the end of July 2014 — could help law enforcement authorities reconcile these two important demands.

Surveillance is an increasingly common — and sometimes controversial — activity, designed fundamentally to protect the public and property. The rapid increase in information gathered by surveillance cameras however has led to spiralling costs in terms of storage filtering and data checking, and has also led to concerns that innocent citizens are routinely being tracked.

The project sought to streamline surveillance through the development of a number of decision-support technologies. These technological innovations are based on video analytics, using data methods that search tags and fuse data from both multimedia sources and information databases.

The distributed intelligence within the platform enables decision support for automated detection, recognition, geo-location and mapping, including intelligent decision support at various levels to enhance situation awareness, surveillance targeting and camera handover. The technology also enables cameras to filter out unimportant events, meaning that surveillance is more focused and targeted.

This means that the privacy of citizens is safeguarded, while law enforcement authorities are able to reduce the number of man hours spent sorting through raw data.



The project team worked closely with law enforcement agencies to ensure that their tools were practical and applicable. An analysis of end-user requirements from police and CCTV operators was carried out, and helped in the design of the overall MOSAIC architecture.

Prototype MOSAIC components for data representation, text and data mining, social and criminal network analysis and decision support were then successfully developed. The design of a new smart camera system capable of being integrated into the MOSAIC platform was also completed. The final integration of all these MOSAIC components achieved an overall satisfaction level of 79.88% in final trials with end users.

The MOSAIC project will have important implications that extend beyond law enforcement. Analytical innovations could also be relevant to other areas such as the analysis of shopping behaviour, social networks, speech analytics or data mining.

The team is now looking at the possibilities of developing the technology further, along with the potential commercialisation of the complete platform. Further development and the commercialisation of individual platform components are also being investigated.

MOSAIC

- ★ Coordinated by the University of Reading in the United Kingdom.
- ★ Funded under FP7-SECURITY.
- ★ <http://cordis.europa.eu/news/rcn/122253>
- ★ Project website: <http://www.mosaic-fp7.eu/>

EFFICIENT RESOURCES FOR TELECOMMUNICATIONS

An EU-funded project has sought to reduce interference in wireless networks through advanced techniques.

One of the main challenges in heterogeneous networks is to manage interference between different wireless elements. To this end, new approaches for easy co-existence are urgently required to efficiently allocate resources.

“COMIC proposed an optimal algorithm to provide users with a certain target quality of service in interference-free heterogeneous networks.”

The EU-funded project COMIC (Cooperative multipoint transmission for interference coordination) sought to mitigate interference in such networks based on efficient scheduling and a special signal processing technique known as beamforming. The uplink was modelled as a ‘Multiple access channel’ (MAC) and the downlink as a ‘broadcast channel’ (BC).

To achieve beamforming and remove interference in MACs, scientists focused on a specific technique known as ‘Successive interference cancellation’ (SIC). SIC proved to be a more

efficient technique compared to dirty-paper coding which was implemented during the first year for BCs.

COMIC proposed an optimal algorithm to provide users with a certain target quality of service in interference-free heterogeneous networks. Although such networks are still ideal, this algorithm proved practical.

Work was also geared toward realising ‘cooperative multipoint’ (COMP) schedulers for efficiently allocating resources. Project members managed

to develop a femtocell for a long-term evolution network with COMP capabilities.

Project results were published in two papers relating to fair resource allocation in heterogeneous networks.

COMIC

- ★ Coordinated by the Polytechnic University of Valencia in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151697>



BETTER ONLINE RECOMMENDATIONS

Online retail and similar systems often make inappropriate recommendations. An EU project has introduced systems that use contextual relationship algorithms to better determine a user's likely preferences.

Systems used for online shopping commonly make suggestions to users about other products. Yet the recommendations are often not fully relevant, necessitating a system that utilises all available customer information to make more targeted suggestions.

The EU-funded CARS (Context-aware recommender systems) project aimed to

build such a recommendation system for mobile and desktop devices. The system takes advantage of the full contextual relationship between user and item. The consortium's activities began at the end of 2011 and lasted two years.

Achievements included developing five novel algorithms for collaborative filtering, which outperform competitors. The algorithms were integrated into an application (app) called

“The CARS project advanced the field of context-based recommendation systems.”



Frappe for Android mobile devices. The app recommends other apps the user might like. The app uses contextual information from the mobile phone sensors to find similar products that may meet the apparent needs of the user. The project work also included evaluating the app's usefulness and impact.

Project results were published as conference and workshop papers, two of which received Best Paper awards.

The CARS project advanced the field of context-based recommendation systems. As a result, new systems will provide more relevant suggestions, potentially leading to further purchases.

CARS

- ★ Coordinated by Telefonica Research and Development SA in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151714>

BIOMIMETIC CONTROL IN BIPED ROBOTS

To date, we have been unable to replicate the locomotory and manipulation capabilities of humans in biped robots due to issues with stability and energy consumption. EU-funded researchers are now resolving this to produce a controlled and compliant biped robot.

The EU-backed project H2R (Bringing human neuromotor intelligence to robots) worked on combining machine learning techniques with advanced control theory to develop human behaviour-based motor control mechanisms for robots using modelling and other analytical tools.

H2R began with the study of key human features enabling adaptation to dynamic environments — force and impedance. Electromyography signals were used to better understand muscle activation and improve motion, impedance and force control in robots.

After studying how humans utilise impedance to carry out tasks, H2R developed an optimal impedance model reference control using linear quadratic regulator optimisation techniques. These adaptation algorithms were modified after modelling and analysis for application in exoskeleton robots used in assistive human rehabilitation. These were also applied on an iCub robot, a humanoid robot, to improve its performance carrying out bimanual manipulation tasks. iCub was developed in the EU-funded project RobotCub.

To improve robotic balance and control, project members developed a non-linear adaptive generator of indirect control trajectories. They successfully used this to control a wheeled inverted pendulum system and mobile manipulators.

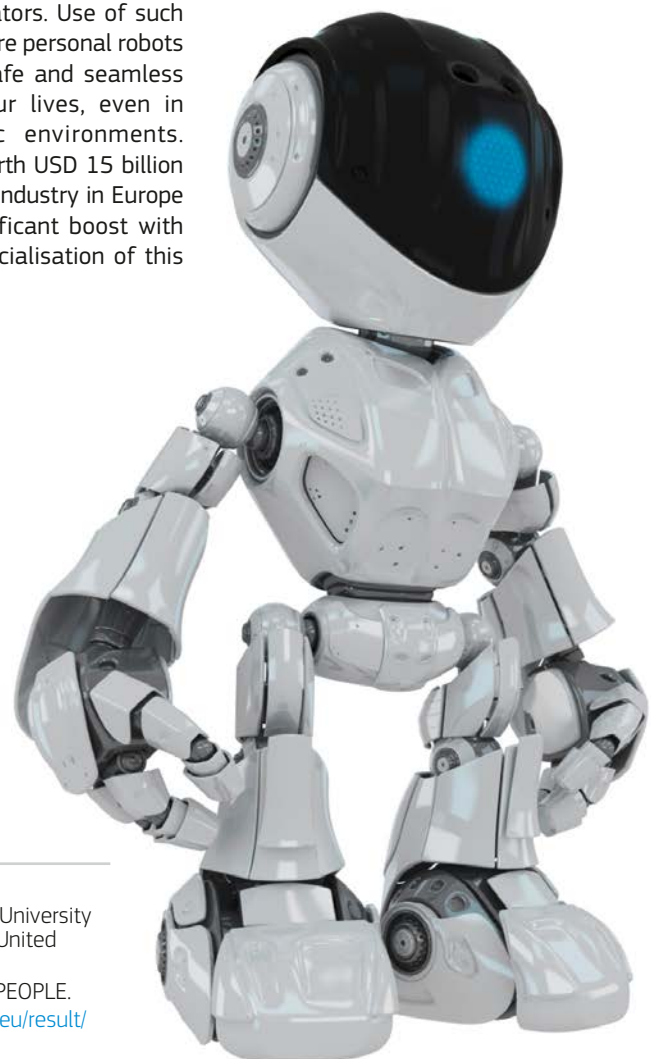
Researchers also developed a computational model to improve tracking through adaptation of reference trajectories. The algorithms developed helped improve robotic sensory capabilities in terms of perceiving and manipulating objects without requiring force sensors. Experiments were

also carried out to improve kicking performance in robot leg joints.

H2R outcomes were disseminated via numerous seminars, talks, research collaborations, academic visits and exchanges to other institutes in Europe and China.

Project activities have enabled the development of biomimetic robot control technologies that were tested on exoskeleton robots, humanoid robots and robot manipulators. Use of such technologies in future personal robots will enable their safe and seamless integration into our lives, even in unknown dynamic environments. Estimated to be worth USD 15 billion by 2015, the robot industry in Europe will receive a significant boost with successful commercialisation of this technology.

“Use of project technologies in future personal robots will enable their safe and seamless integration into our lives, even in unknown dynamic environments.”



H2R

- ★ Coordinated by the University of Plymouth in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151599>

INDUSTRIAL TECHNOLOGIES

FIGHTING SEAWEED WITH GREEN TECHNOLOGY

Biofouling — or biological fouling — is the build-up of plants, algae and other marine organisms on wet surfaces, which can corrode and damage objects such as ships, pipes and bridge supports. The problem has long defied engineers and scientists. However, a recent EU project has developed a novel green technology that applies special coatings on vulnerable surfaces to control biofouling.

The research team in the EU-funded project SEACoAT (Surface Engineering for Antifouling — Coordinated Advanced Training) studied the processes involved in the colonisation of marine fouling organisms on surfaces and helped develop new, environment-friendly materials and coatings to treat them. The researchers examined the physical and chemical properties of surfaces at nano- and micro-scale to see how they influenced the adhesion of fouling organisms.

A key breakthrough of the project was the use of surface engineering technologies to build coatings adapted for different surface properties. They were tested with advanced imaging techniques such as digital holography. The first results reduced the initial adhesion of marine bacteria, spores of seaweeds and the larvae of barnacles while lowering the attachment strength of those organisms that did manage to adhere.

In terms of the costs of biofouling, James Callow, SEACoAT project coordinator, Professor of Plant Science at the University of Birmingham in the United Kingdom, says: 'Even before corrosion occurs, organic growth can increase the roughness of ship hulls, affecting manoeuvrability, increasing drag and raising a ship's fuel consumption by up to 30%. The global annual cost of hull fouling is estimated to be USD 180 to 260 billion.'

'Marine biofouling is economically and environmentally expensive and affects the competitiveness of European companies operating in different areas of the marine environment, from commercial shipping to underwater structures like oil rigs and wind farms,' explains Callow. 'This is important for Europe: while the problem of marine biofouling is worldwide, the majority of the companies that manufacture marine antifouling coatings are European,' he adds.

The project, funded by the EU's Marie Curie programme which supports early-stage researchers,

"We have trained a group of young researchers within an interdisciplinary area who now have the skills needed for future research on marine biofouling."

among others, brought together six universities and two business partners to provide training to 21 young scientists. 'We have trained a group of young researchers within an interdisciplinary area who now have the skills needed for future research on marine biofouling,' says Callow.

SEACOAT's coordinator believes that the Marie Curie training courses could give the 21 young fellows a competitive advantage when applying for research positions in the subject area. The researchers are able to demonstrate expertise in synthesising novel antifouling coatings, understanding their physical and chemical properties and characterising their biological performance.

Furthermore, the training courses promoted trans-national, interdisciplinary and inter-sectoral research, while giving each trainee transferable lifetime skills. 'The training is also expected to help the fellows' future careers in biomedical science since the problem of fouling of medical devices such as stents — with bacteria or other organisms — is similar in many respects to the fouling of ships and other structures in the marine environment,' concludes Callow.

SEACOAT

- ★ Coordinated by the University of Birmingham in the United Kingdom.
- ★ Funded under FP7-PEOPLE.
- ★ http://ec.europa.eu/research/infocentre/article_en.cfm?artid=33738
- ★ Project website: <http://www.birmingham.ac.uk/generic/seacoat/index.aspx>

INFORMED DESIGN OF SUPERIOR PANELS

Panels play a critical role in the performance of cars, aircraft, boats and buildings. EU-funded scientists have validated design tools and increased understanding of how structure relates to function for rapid realisation of improved concepts.

Panels not only impart structural support but also modify acoustics and vibration and can be specialised to provide thermal and fire-retardant properties. Despite major advances in mechanical engineering designs and panel performance, detailed knowledge of the behaviour of these panels under varying conditions is still limited.

Backed by EU funding, scientists in the project SUPERPANELS (Strengthening and upholding the performances of the new engineered research panels) applied novel, predictive, structural and structural-acoustic tools to test and verify them against experimental data. Outcomes have been important for validation of the tools themselves and have elucidated mechanisms for increases in performance of certain panels. In addition, through numerous secondments among the five partners, fellows received broad cross-disciplinary training bridging mechanical engineering and transportation. The partners have already agreed to continue the collaboration beyond the scope of the project.

Understanding the correlation between structure and function will enable better knowledge-based design of panels in the future. The transport and construction sectors can immediately begin testing their new design concepts with the predictive design tools which have been validated by SUPERPANELS' project scientists.

SUPERPANELS

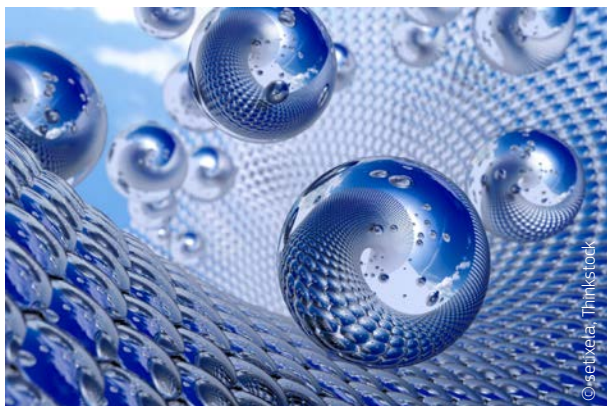
- ★ Coordinated by the University of Naples Federico II in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151639>
- ★ Project website: <http://www.superpanels.unina.it/SUPERPANELS/Home.html>

"The transport and construction sectors can immediately begin testing their new design concepts with the predictive design tools which have been validated by SUPERPANELS' project scientists."



PROVIDING A CLEARER PICTURE OF NANOTECHNOLOGY'S FULL POTENTIAL

EU scientists have developed a unique tool that enables scientists to carry out numerous nanoscale measurements in one go.



A new tool capable of carrying out simultaneous nano-sized measurements could soon lead to more innovative nanotech-based products and help boost the EU economy. The tool, developed by scientists cooperating through the EU-funded UNIVSEM (Universal SEM as a multi-nano-analytical tool) project, has the potential to revolutionise research and development in a number of sectors, ranging from electronics and energy to biomedicine and consumer products.

Nanotechnology, which involves the manipulation of matter at the atomic and molecular scale, has led to new materials — such as graphene — and microscopic devices that include new surgical tools and medicines. Up until now however, nanotech R&D has been hampered by the fact that it has not been possible to produce simultaneous information on 3D structure, chemical composition and surface properties.

This is what makes the UNIVSEM project, due for completion in March 2015, so innovative. By integrating different sensors capable of measuring these different aspects of nano-sized materials, EU scientists have created a single instrument that enables researchers to work much more efficiently. By providing clearer visual and other sensory information, the tool will help scientists to manipulate nano-sized particles with greater ease and help cut R&D costs for industry.

The project team began in April 2012 by developing a vacuum chamber capable of accommodating the complex sensory tools required. In parallel, they significantly improved the

capabilities of each individual analytical technique. This means that users now need just one instrument to achieve key capabilities such as vision and chemical analysis.

Preliminary tests demonstrated that the achieved optical resolution of 360 nanometres (nm) far exceeds the original 500 nm target set at the start of the project. This should be of significant interest to numerous sectors where cost-efficient but incredibly precise measurements are required, such as in the manufacture of nano-sized surgical tools and nano-medicines.

Electronics is another key area. For example, the UNIVSEM project could help scientists learn more about the properties of quasiparticles such as plasmons. Since plasmons can support much higher frequencies than today's silicon-based chips, researchers believe they could be the future for optical connections on next-generation computer chips.

Plasmon research could also lead to the development of new lasers and molecular-imaging systems, and increase solar cell efficiencies due to their interaction with light. Another exciting area of nanotechnology concerns 'silver nanowires' (AgNWs). These nanowires can form a transparent conductive network, and thus are a promising candidate for solar cell contacts or transparent layers in displays.

The next stage is the commercialisation of the instrument. The multi-modal tool is expected to spur nanotechnology development and enhanced quality control in numerous areas — such as the development of third generation solar cells — and create new opportunities in sectors that have until now not fully tapped into the potential of nanotechnology.

The UNIVSEM project has been supported through the EU's Seventh Framework Programme with funding amounting to EUR 3.6 million.

UNIVSEM

- ★ Coordinated by Tescan in the Czech Republic.
- ★ Funded under FP7-NMP.
- ★ <http://cordis.europa.eu/news/rcn/122251>
- ★ Project website:
<http://www.univsem.eu/>
- ★  <http://bit.ly/1F5UnUa>

ENHANCING PLASMONIC WAVEGUIDES

EU scientists have been working on a cutting-edge project, where liquid crystals have been used to design functional plasmonic components.

Successful exploitation of high-bandwidth optical communication channels in integrated data centre architectures and routing platforms is based on small-footprint, low-latency and low-consumption technologies. Plasmonic optical

interconnects are a promising solution, provided that adequate control in terms of their switching and data routing efficiency is ensured.

The EU-funded project ALLOPLASM (Tunable liquid-crystal long-range

surface plasmon polariton components) developed novel plasmonic switching components that were electro-optically controlled by nematic liquid crystalline materials for use in integrated photonic circuitry. This involved designing, analysing,

modelling and fabricating plasmonic structures enhanced with liquid-crystal layers capable of performing the target switching functions.

“ALLOPLASM analysed highly dispersive materials and developed time domain methods for studying liquid-crystal photonics and plasmonic structure.”

ALLOPLASM employed a variety of numerical analysis methods for waveguide electromagnetic analysis and study of the liquid-crystal orientation. Based on a finite element method, scientists addressed the anisotropic nature of the liquid-crystal plasmonic waveguide.

Eigenmode expansion allowed a rigorous analysis of light wave propagation in longitudinal plasmonic switching components. Furthermore, ALLOPLASM analysed highly dispersive materials and developed time domain methods for studying liquid-crystal photonics and plasmonic structure.

By employing these numerical tools, scientists were able to design and study a variety of liquid-crystal plasmonic components for optical interconnects, demonstrating advanced performance characteristics. This included in-line, long-range plasmonic variable attenuators and phase shifters, directional coupler plasmonic switches for planar and 3D multi-level architectures, and in-line dielectric-loaded plasmonic phase shifters.

In all cases, switching properties were induced through electro-optic control of properly designed liquid-crystal layers and cavities. This led to reduced consumption of overall power well below that of thermo-optical plasmonic switches. Researchers fabricated and characterised experimental samples. The expected plasmonic components should provide an ultra-low-power consumption solution for inter-chip or on-chip optical interconnects.

ALLOPLASM

- ★ Coordinated by the National Research Council in Italy.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151672>
- ★ Project website: <http://opto1.artov.imm.cnr.it/allopasm/index.php/about-bar>

MONITORING SALINITY IN WELL STREAMS

Management of below-sea oil production installations can be affected by a failure to measure salinity in well streams, resulting in losses for the operator. EU-funded engineers have therefore developed a sampling and analysis system for monitoring salinity levels.

‘Multi-phase flow meters’ (MPFMs) are used at sea to measure the individual flow rates of oil, gas and water in the well stream. The majority of MPFMs use technology that is heavily influenced by variations in salinity. However, variations in technology can result in inaccurate flow rate data, resulting in poor well management and less-effective processing of the multi-phase flow.

With EU funding, the SALINITYSCAN (Development of system for semi-continuous monitoring of salinity in well streams to remove volume measurement errors and detect water breakthrough) project developed a system for the semi-continuous monitoring of salinity in well streams. The purpose was to remove volume measurement error and detect water breakthrough. The latter occurs when the well begins to produce sea water that was previously injected into the well to increase pressure. It can also result from water penetrating the oil-carrying layer in the reservoir.

The system is based on the development of an analysis chamber equipped with level measurement and salinity sensors for analysing the separated multi-phase fluid. Project partners also designed an extensive control system that provides the end user with an easy way of ensuring increased flow and better exploitation of the well.

Sensors needed to have a high degree of reliability and safety as well as the ability to operate with a variety of multi-phase fluids in a harsh environment. These conditions involve extremes of pressure and temperature. Because of these demanding conditions, project partners developed and tested many different types of level measurement sensors.

SALINITYSCAN data was used to update the flow meter calibration parameters, thereby compensating for any changes caused by variations in salinity. The semi-continuous

monitoring of salinity makes it easier to detect water breakthroughs. The technology can also be used as a tool for measuring salinity in order to determine the need to inject chemicals to inhibit hydrate formation.

Combining the SALINITYSCAN system with an MPFM unit will provide many benefits, including increased revenue as a result of correct data from flow meters. It will also help extend the life of the field through improved reservoir management. In addition, the technology will reduce the use of anti-scaling chemicals through better measurement of salinity and pH of produced water.

SALINITYSCAN

- ★ Coordinated by Teknologisk Institutt in Norway.
- ★ Funded under FP7-SME.
- ★ <http://cordis.europa.eu/project/rcn/97525>



PHYSICS AND MATHEMATICS

A NOVEL CAVITY QED SYSTEM

Confining atoms in miniscule structures with walls that reflect light (resonators) has provided an experimental setup for EU-funded scientists, enabling them to push the boundaries in the study of light–matter interactions at the quantum level.

The cavities physically constrain the wavelength of photons that the atoms emit or absorb. The behaviours of constrained, excited atoms provide important insight into interactions between light and matter, phenomena that are inherently both classical and quantum at the same time.

Cavity ‘quantum electrodynamics’ (QED) has emerged as an important field of study. Deeper understanding will lead to knowledge-based design for applications in quantum computing and quantum memory. The EU-funded project CQODAR (Cavity QED at the one-dimensional atom regime with chip-based micro-resonators) has developed a completely new cavity QED system.

The system couples single ultracold atoms with chip-based microtoroid

resonators through a tapered optical fibre. This has opened an important observational window on single atom – single photon interactions with a focus on photon – photon interactions. The highly advanced setup can deliver supercooled atoms from a magneto-optical trap to within 200 nanometres of the toroid surface.

Scientists used fibre-based electro-optic modulators and electronic equipment operating at rates greater than five gigahertz. As a result, they could detect an atom’s presence and emitted single photon all within about two microseconds, less than a typical atom-transit duration.

Researchers conducted a detailed theoretical study published in ‘Physical Review A: Atomic, Molecular and Optical Physics’. It formed the basis of two novel experiments — catastrophe

optics (dealing with geometrical singularities in ray patterns) and spontaneous emission from a single atom. The latter was published in *Physical Review Letters*.

The CQODAR team developed a state-of-the-art experimental setup. Precise control of single ultracold atoms to determine the behaviours and properties of the single photons emitted is now possible as a result. The technology is expected to make an invaluable contribution to the understanding of quantum interactions between matter and light.

CQODAR

- ★ Coordinated by the Weizmann Institute of Science in Israel.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151666>

MOLECULES THAT COOPERATE IN NOVEL WAYS

Molecules in liquid state can come together in unique ways, forming solid or solid-like materials in the case of gel or glass. EU funding has helped elucidate relationships between microscopic mechanisms and complex dynamic behaviours.

Network-forming liquids are part of the general class of complex fluids characterised by an inherent coupling between their structure and dynamics. They are an excellent experimental paradigm in which to evaluate the unique behaviours of soft matter. EU-funded scientists initiated the project NFLIQUID (Dynamics and structure in a network-forming liquid) to investigate cooperation found in many different materials.

Using a variety of numerical methods and modelling techniques, scientists explored a simple model composed of meso-particles in a water solvent linked by polymers. Their

work took two paths: the first analysed the competition between glass and gel formation (the interplay between

“Outcomes have advanced the field of soft-matter physics.”

glassy arrest and gelation); the second consisted of studies regarding the ‘Potential energy landscape’ (PEL) which provides an indicator of transitions between phases and dynamic behaviour.

A continuous-time random walk model revealed the complex interplay between glassy arrest and gelation. The behaviour is controlled by two different localisation length scales. Each of these, in turn, is characterised by competing interactions. Both systems were recreated experimentally with colloid-polymer mixtures.

The PEL highlights the complicated multi-particle (many-particle) effects in complex systems. Studies led to a modified description facilitating identification of the length scales of cooperative motion and evaluation of the effects of system size on dynamics.

Outcomes have advanced the field of soft-matter physics. Deeper understanding of the complex dynamic behaviours

of soft matter will enhance development of future products and improve processing methods. Results have been widely disseminated at international conferences and collaborations established are ongoing.

NFLIQUID

- ★ Coordinated by the University of Granada in Spain.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151663>



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LIMITS IN INTERFEROMETRIC MEASUREMENTS

An EU project sought to provide further insight into the noise caused by radiation pressure between laser and matter interaction by using optomechanical cavities.



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Interferometry is widely used in measuring small displacements with very high sensitivity values. However, even though traditional sources of error have been eliminated from the measurement process, quantum noise is limiting gravitational wave or table-top interferometer sensitivities.

To further study this phenomenon, the EU-funded project QOOMS (Quantum optics with optomechanical systems) developed an optomechanical resonator where ‘Quantum radiation pressure noise’ (QRPN) prevailed over thermal noise. The resonator’s highly

reflective mirror surfaces allowed high optical finesse and increased the intracavity intensity fluctuations that give rise to QRPN.

“Project work significantly enhanced knowledge about quantum noise in interferometric measurements.”

Scientists used a set-up where correlations between two light beams were created and sent into a high-finesse

optical Fabry-Perot cavity. Monitoring correlations between the intensity of the first beam and the phase of the probe beam enabled them to demonstrate the QRPN effects. As contamination was apparent in measurements, scientists operated the cavity in a cryostat, thus reducing thermal noise by two orders of magnitude.

QOOMS also developed a quartz micro-mechanical resonator and integrated it in the set-up. Several techniques were developed for coating the high-reflectivity mirror on top of the resonator. The high optical finesse provided by such low-loss coatings dramatically increased both displacement sensitivity and QRPN effects.

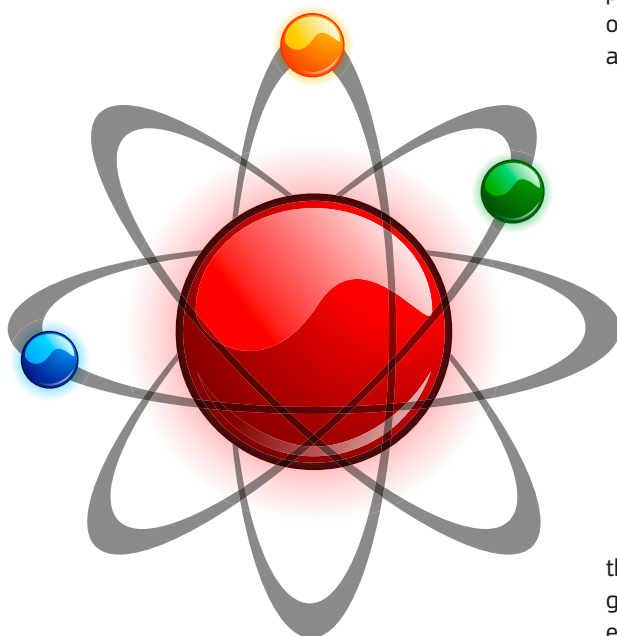
Project work significantly enhanced knowledge about quantum noise in interferometric measurements.

QOOMS

- ★ Coordinated by the National Centre for Scientific Research in France.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151654>

QUANTUM DOT SPIN PHOTON INTERFACE

To carry out quantum information processing or quantum communication, scientists believe it is necessary to combine or connect stationary quantum bits (qubits) with mobile or 'flying' qubits.



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The EU-funded QUANTUMDOTS (Experimental generation of distant quantum dot spin entanglement) project used quantum dots to generate an interface between a stationary qubit (spin) and a flying qubit (photon). A propagating photon can be used for the transmission of quantum information, and a stationary qubit can be used for storage and manipulation. As a critical resource in quantum computation and quantum communication, the researchers created entanglement

"The QUANTUMDOTS researchers described the process and results in papers they published in the Nature and Nature Communications magazine."

between a stationary qubit and a flying qubit based on a quantum dot system. Subsequently, they used this resource for the teleportation of quantum information between two quantum dots.

Broadly speaking, entanglement represents a strange phenomenon in quantum physics, which Albert Einstein referred to as 'Spooky action at a distance'. In a pair of entangled

particles, the measurement of one side will determine the outcome of the other side immediately, no matter how far apart they are.

Specifically, electron and hole spins can be confined in the quantum dot, and the combination of them emits flying photons. Therefore, quantum dots are ideal candidates for spin-photon interface and spin-photon entanglement. In type three-level quantum dot systems, spin direction is used as a qubit, and the colour (frequency) of a single photon is used as another qubit. Following the decay of the excited state, the emission of a blue photon will lead to the spin up state, and the red photon will lead to the spin down state; the two cases together form an entangled superposition state.

To demonstrate its application, a teleportation experiment has been implemented. There are three steps in this experiment. First, one flying photonic qubit has been generated with one quantum dot. Second, spin-photon entanglement has been created with the second quantum dot. Third, upon the interference of the two photons on a beam splitter, quantum information from a flying photon has been transferred to the quantum dot spin.

The QUANTUMDOTS researchers described the process and results in papers they have published in the Nature and Nature Communications magazine. It is hoped that the spin-photon entanglement will be a key enabling technology for a distributed approach to quantum information processing and new computing devices.

QUANTUMDOTS

- ★ Coordinated by the Swiss Federal Institute of Technology Zurich in Switzerland.
- ★ Funded under FP7-PEOPLE.
- ★ <http://cordis.europa.eu/result/rcn/151658>

EVENTS

APRIL

07►11

Sölden, AUSTRIA

CONFERENCE

17TH INTERNATIONAL NEUROSCIENCE WINTER CONFERENCE

The 17th International Neuroscience Winter Conference will take place from 7 to 11 April 2015 in Sölden, Austria.

The conference programme will include keynote lectures, symposia and special interest sessions. Some key note speakers have already been announced. They include Bernhard Bettler from Switzerland speaking on 'Molecular insights into the regulation of GABAB receptor trafficking and signaling' and Alejandro Schindler from Argentina discussing 'A novel view of neurogenesis and memory encoding in the dentate gyrus'.

Contributions from participants in the field of basic and clinical neuroscience are welcome. Submitted abstracts will be presented as posters. The regular registration fee is EUR 330, while the student fee is EUR 165.

For further information, please visit:
<http://www.winterneuroscience.org/2015/>

APRIL

14►16

Southampton, UK

CONFERENCE

OCEAN BUSINESS 2015

The 'Ocean Business 2015' conference will be held from 14 to 16 April 2015 in Southampton, UK.

The event combines an international exhibition and a technical conference which will provide the community with insights into the technology, operations and business issues in the global field of offshore surveying. The conference aims to offer a platform for sharing cutting-edge information with an international audience. Sessions will cover topics including sub-sea positioning, advanced survey techniques, survey operations, data processing and visualisation, as well as other industry issues.

At the exhibition, which is free of charge, visitors will be able to test-drive equipment at sea, at the dockside, in a test tank and in classrooms. The event is hosted by the Society of Maritime Industries in partnership with the UK National Oceanography Centre.

For further information, please visit:
<http://www.oceanbusiness.com/>

APRIL

19►22

Rungstedgaard, DENMARK

CONFERENCE

THE BRAIN CONFERENCES: BRIDGING NEURAL MECHANISMS AND COGNITION

This meeting, taking place in Rungstedgaard, north of Copenhagen, is part of a new series of high-level bi-annual Brain Conferences in Europe. The Brain Conferences are organised by the Federation of European Neuroscience Societies (FENS, the major neuroscience association in Europe) in partnership with The Brain Prize. They bring together outstanding researchers in key broadly defined areas of contemporary neuroscience to discuss current concepts and define challenges for future research.

From behavioural and brain-imaging studies, human cognitive scientists infer that the human brain must contain networks dedicated to the mental representation and manipulation of quantities, distances, probabilities and even more complex structures such as symbols and linguistic trees — yet their neuronal implementation remains uncertain.

Co-chaired by Stanislas Dehaene (Collège de France) and Mihe Shadlen (Columbia University, USA), the aim of this Brain Conference is to examine the possibility of identifying a small set of bridging laws linking neuronal codes to identified cognitive computations.

For further information, please visit:
<http://www.fens.org/Meetings/Brain-Conferences/Bridging-neural-mechanisms-and-cognition/>

EVENTS

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

APRIL

24►25

Istanbul, TURKEY

CONFERENCE

2015 FIFTH INTERNATIONAL CONFERENCE ON LIFE SCIENCE AND TECHNOLOGY (ICLST 2015)

The 2015 Fifth International Conference on Life Science and Technology (ICLST 2015) will take place from 24 to 25 April 2015 in Istanbul, Turkey.

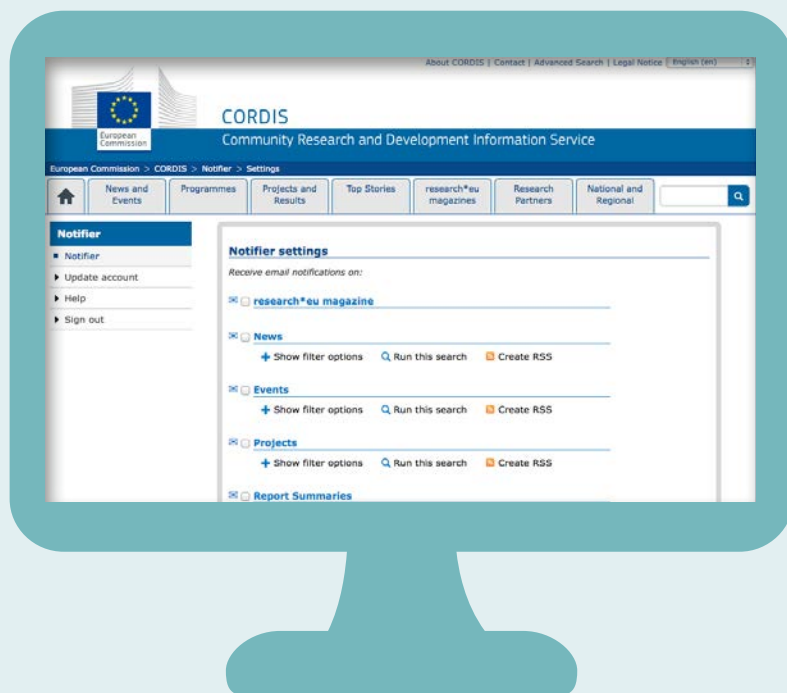
ICLST 2015 aims to create a common forum for innovative academics and industrial experts in the field of life science and technology. The primary goal of the conference is to promote research and development activities in these areas. Another goal is to promote scientific information interchange between researchers, developers, engineers, students and practitioners working in Turkey and abroad.

Full papers should be submitted before 1 February 2015. Registration fees range from approximately EUR 250 to approximately EUR 380.

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



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