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MARCH 2019

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Hidden secrets of the global seafood trade revealed

SPECIAL FEATURE
FROM ASIMOV TO ALL
AROUND US - WELCOME TO
THE ROBOT REVOLUTION



Editorial

The robot revolution looms before us and an innovative device to help partially-sighted children comes closer to the market –

welcome to this month's official Research*eu magazine

As we approach the beginning of the 2020s and with so much uncertainty afflicting modern life, it is very easy to become rather gloomy about the state of the world. But innovations are constantly taking place and aim to actually make our lives just that little bit better. However, some of these innovations can be considered as double-edged swords. The continuing advancement of the robotics industry, the focus of this month's special feature, is one such sector that could elicit feelings of both excitement and dread. The former due to the increasing sophistication of robots that are increasingly able to undertake complex tasks, the latter due to the socio-economic fears of how the increasing automation of our industries and society can impact on certain industries and their workers.

Alas, whilst these concerns are valid and deserve robust debate to ensure that policies are put in place to reduce social disruption and economic dislocation as much as possible, the evidence thus far points to robotics being a key tool to help resolve many of the pressing issues that we face today. Our special feature this month contains seven EU-funded projects that are at the forefront of the ongoing robotics revolution, as well as highlighting Europe's pole position in the global competition for robotics' innovation.

The wonders of technology are also showcased in **Life After**, where we have a catch-up with Dr Monica Gori, who was coordinator of the **ABBI** project, which has pioneered a wearable device that helps partially-sighted children develop a better sense of space and improve their social skills.

In our **nine regular thematic sections**, we treat you to articles exploring topics as diverse as Charles Dickens (making the British element of the CORDIS editorial team reminisce/recoil over memories of high school English classes), customised solutions to improve railway productivity (probably an issue many of our commuting readers might like to see more fully addressed), and one project that made pork products the focus of its research (stick with us on this one, don't go bacon our hearts...).

Finally, **EU Agenda** highlights upcoming EU-funded project-led events and international days, and if you'd like to send us your feedback, questions and/or suggestions (which are always welcome and very gladly read), please send them to:

editorial@cordis.europa.eu

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Editorial coordination
Birgit Alice BEN YEDDER

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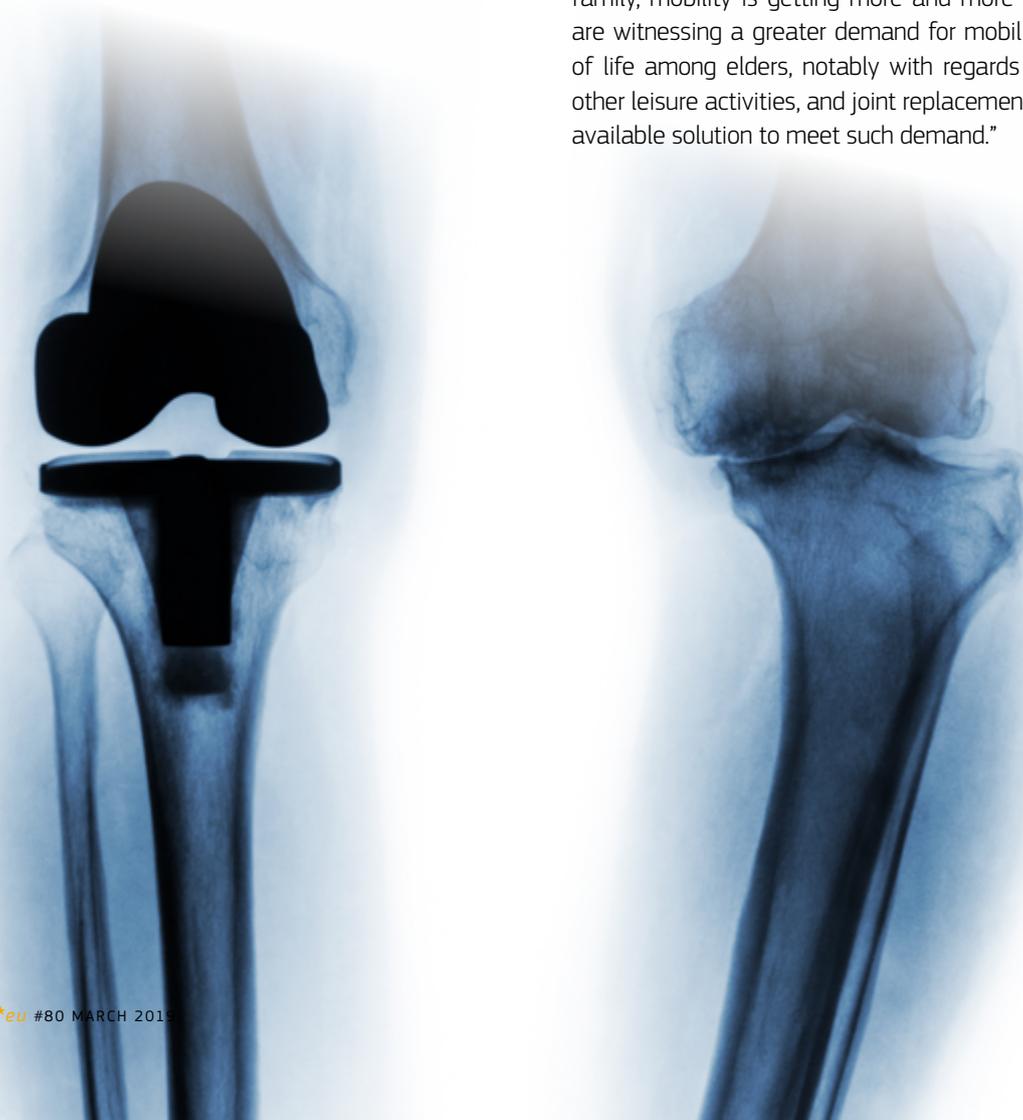


New-generation joint replacement materials can prevent adverse immune reaction

Adverse immune reaction (AIR) is a growing problem for elders in need of artificial joints. The HYPORTH consortium has developed not only a method to predict the risk of AIR, but also a range of hypoallergenic materials that can be tailored to patients' needs – preventing risk of complications.

At first glance, the increasing success of orthopaedics that goes hand-in-hand with ever-aging populations is full of promises: instead of just living longer, we can now hope that this growing age won't have too much impact on our lifestyles. Working a few more years, or enjoying retirement with a busy schedule is within reach.

As Prof. Christoph Lohmann, coordinator of the HYPORTH (New approaches in the development of Hypoallergenic implant material in Orthopaedics: steps to personalised medicine) project on behalf of the University of Magdeburg, points out, joint replacements are particularly important to allow these dreams to come true. "Considering how most elderly people are living alone, sometimes far away from their family, mobility is getting more and more important. We are witnessing a greater demand for mobility and quality of life among elders, notably with regards to sports and other leisure activities, and joint replacements are the best available solution to meet such demand."



Joint replacements, however, don't age too well. An increasing number of patients need to receive revision surgery due to complications, 10% develop AIR to conventional implant material, and 10% contract an infection. Not only can such periprosthetic infections not be avoided, but the numbers are constantly growing due to changing resistances and – to make things worse – no good predictive markers have yet been established to foresee such problems.

“The main issue we face is loosening due to the likes of disintegration of prosthetic components, adverse reactions to biomaterials or malposition of implants, and infections which leave surgeons with no other choice but to revise or change prosthetic components. This problem is growing all over the world and represents a major burden for the patient and the health system in general,” says Prof. Lohmann.

This is the context in which the HYPORTH consortium was created. Over five years, the team led by Prof. Lohmann devised a predictive approach using biomarkers to identify patients at risk of developing AIR, and created new hypoallergenic material combinations for endoprostheses to avoid the immune reactions seen with conventional materials.

The implant's materials – hypoallergenic materials made of ceramics, polymers, pure titanium, or titanium particulate coatings that are wear resistant and biocompatible – can even be matched with the allergenic background of patients. As Prof. Lohmann points out, “implants may

“ *Implants may be individualised through production in certain 3D-print systems based on the anatomy of the patient and his/her potential allergies.* ”

be individualised through production in certain 3D-print systems based on the anatomy of the patient and his/her potential allergies. Moreover, these implants can be equipped with sensors in order to diagnose loosening early.”

Another important project outcome is the development of tests able to differentiate between AIR and septic loosening.

“Our prototypes will undergo clinical evaluation soon. Once it's done, we will be planning for follow-up projects dealing with antibacterial surface modifications and sensors, as well as establishing new predictive and diagnostic biomarkers for better care,” Prof. Lohmann concludes.

HYPORTH

- Coordinated by Otto von Guericke University Magdeburg in Germany.
- Funded under FP7-HEALTH.
- cordis.europa.eu/project/id/602398
- Project website: hyporth.eu

HEALTH

Helping cancer patients to manage their cancer effectively

Medical advances have led to more positive prognosis for many cancer patients and more are living for longer. This means that the disease is frequently managed as a chronic condition, necessitating long-term monitoring, and in some cases, ongoing medication. One EU-supported project is making it easier for patients and their carers to manage their own treatment.

Over the last 20 years, personal health record systems have faced many challenges due to issues of trust, lack of interoperability and limited usefulness to the patient. The EU-supported iManageCancer (Empowering patients

and strengthening self-management in cancer diseases) project has developed a Personal Health Record (iPHR) system to address these challenges.



“ *The iPHR system empowers patients through self-management, allowing them to involve all stakeholders participating in their care, including family and informal carers if they choose.* ”

repository, e-Consent and information recommender. Three other applications exist for clinicians: annotator, psycho-emotional profiler and smart analytics.

The data gathered can also feed into clinical research. With the help of an e-consent tool, the administrator sends a request to patients with such profiles to support research by permitting their data to be used. If enough patients agree to this, the researcher is allowed to carry out specific analysis of this data in the platform.

Much expertise has gone into the creation of the platform. The European Institute of Oncology (IEO), a comprehensive cancer centre located in Milan, Italy, was responsible for the psycho-emotional tools, including family resilience and a decision aid for prostate cancer patients. The IEO also worked closely with breast and prostate cancer patients to validate the platform.

The Department for Paediatric Oncology and Haematology, Saarland University Medical Center, was responsible for the concept of a game for children, and a clinical pilot with children with cancer. The Division of Cancer Studies at King's College London (KCL) helped to develop predictive tools. Tenovus, a Welsh cancer charity providing mobile chemotherapy, working with eCANCER conducted end user workshops and remote testing with cancer patients throughout the development phase.

IMANAGECANCER

- Coordinated by the Fraunhofer Society in Germany.
- Funded under H2020-HEALTH.
- cordis.europa.eu/project/id/643529
- Project website: imanagecancer.eu
- ▶ bit.ly/2Qjhg6v

“The iPHR system empowers patients through self-management, allowing them to involve all stakeholders participating in their care, including family and informal carers if they choose,” explains the group manager for iManageCancer’s Intelligent Health Information Systems, Dr Stephan Kiefer.

iPHR allows them to monitor their health in real time, better manage their treatment at home and, should they wish, share their information with healthcare professionals, informal carers and supporters for better-tailored care and outcomes.

“As iPHR is open source, patients own their personal health record. Using their own iPHR, they can: search for personalised and verified information; use treatment decision tools; have the ability to record day to day experiences such as side effects and non-prescription medication; access tools for monitoring their psycho-emotional state; and note their environmental, lifestyle and dietary habits. All of these factors provide the patient with a complete overview of their health,” says Dr Kiefer.

To make all this possible, the open source software of tools developed for patients includes nine applications: e-Diary, appointments, problems, medications, measurements, psycho-emotional monitoring, contact, documents

A better understanding of how ALS spreads

Researchers with the EU-funded ExItALS project gain new insight on how Amyotrophic Lateral Sclerosis (ALS) disease spreads so quickly – an important step towards being able to stop it.

Remember the Ice Bucket Challenge? The social media campaign that had everyone from celebrities to politicians dumping buckets of icy water over their heads? Behind the viral videos that saturated our social media feeds was an effort to promote research on ALS – research like that being conducted by the EU-funded ExItALS (RNA-mediated intercellular miscommunication: role of extracellular vesicle cargos in Amyotrophic Lateral Sclerosis) project.

To learn more, we sat down with Project Coordinators Dr Alessandro Quattrone, a Professor of Experimental Biology at the University of Trento, and Manuela Basso, a Principal Investigator at the University of Trento's Department of Cellular, Computational and Integrative Biology (CIBIO).

What is Amyotrophic Lateral Sclerosis?

Quattrone: Amyotrophic Lateral Sclerosis, or ALS, is a rare neurodegenerative disorder that primarily targets upper and lower motor neurons – leading to the inability to control voluntary movements. Like other chronic neurodegenerative diseases, ALS starts at one focal point before spreading to the entire nervous system, including the brain and spinal cord.



Manuela Basso
Principal Investigator at the University of Trento's Department of Cellular, Computational and Integrative Biology and
Dr Alessandro Quattrone
Project coordinator and Professor of Experimental Biology at the University of Trento
© ExItALS

“There is no cure for ALS, so our focus is on trying to determine what causes the disease to spread. If we know this, then we can begin developing strategies for stopping it from spreading.”

Basso: As the disease spreads, motor neurons, those that control specific muscle movements, begin to degenerate, causing the individual to initially experience difficulties swallowing or performing fine motor movements. Gradually, all muscles under voluntary control are affected, causing the individual to lose the ability to speak, eat, move, and even breathe. Thus, most people with ALS die of respiratory failure, typically within three to five years of when they first start experiencing symptoms.

What does the ExItALS project aim to accomplish?

Quattrone: There is no cure for ALS, so our focus is on trying to determine what causes the disease to spread. If we know this, then we can begin developing strategies for stopping it from spreading.

Do you have any indication of what may be behind the disease's ability to spread so rapidly?

Basso: Motor neurons are supported by glia cells, accessory cells that have been shown to play an important role in the progression of ALS. One of the ways in which glia cells and neurons communicate is through nanoparticles called extracellular vesicles, or EVs. Extracellular vesicles are small pieces of cells that can be formed in various ways and that are released by the cells constitutively, with the rate of their release increasing due to certain stimuli. To illustrate, EVs can be pictured as many little space shuttles being launched from the Space Centre, in this case the cell, to reach and then orbit neighbouring planets.

Quattrone: These EVs are loaded with proteins, RNA and metabolites that reflect the content of the cell's origin. Because EVs are both absorbed by neighbouring cells and able to travel to the periphery of the body (i.e., every system outside the central nervous system), we can use them as biomarkers – a measurable substance whose presence is indicative of some phenomena, such as

diseases. Identifying the EV content that breeds toxicity would allow us to better understand how ALS is spread and, possibly, short-list the disease's biomarkers.

What have been the most important results that the project has achieved thus far?

Quattrone: Perhaps the most important result is the project's ability to generate new ideas and cross-institutional collaboration. For example, due to our collaboration with Manuela Basso, we were able to purify EVs from cells to tissues derived from controlled and disease conditions using a novel and high-performance technique. This is a clear example of the essential role that collaboration plays in scientific research.

Basso: Together, we successfully characterised the genomic and proteomic content of these vesicles and are now setting up new methods to determine which of these EV components cause toxicity. At the same time, we analysed EVs in the plasma of both ALS patients and controls (patients with healthy, neuropathic and muscle dystrophy). From this, we have detected a unique profile for ALS, the results of which will be reported in an upcoming study.

During your research, did you have to overcome any unexpected challenges?

Basso: The biggest challenge we faced was finding a purification method that could be used rapidly and efficiently, and that was also reproducible and pure. But even here we benefited from collaboration, as another research group at CIBIO happened to have such a method. We were able to compare their method to existing ones and then subsequently validate it using a large cohort of samples.

What are you most proud of?

Quattrone: In just a matter of months, we set up a pipeline of experiments that provided us with the opportunity to study the mechanism of intercellular communication using both *in vitro* and *in vivo* ALS models. We were then able to validate the data from these experiments against the samples derived from actual patients. From this, we could better understand how cells communicate with each other via nano-messages and how this communication influences cell performance and well-being.

Although we still do not understand the nature of these nano-messages, thanks to projects like ExItALS, we are now that much closer to being able to decode them.



Could you go into detail on what you mean by nano-messages?

Quattrone: If an EV originates from sick cells, such as motor neurons that are degenerating or glia that are no longer providing support to neurons, they will contain molecules that reflect this damage and thus propagate the malfunctioning. The fact that we can analyse the EVs released by a sick spinal cord in the plasma helps us capture the message from the spinal cord without having to conduct a lumbar puncture, which can be very painful and invasive for a patient affected by a neurodegenerative condition. Furthermore, we are exploring the possibility that the content of the EVs can be used as a biomarker to diagnose the disease in its early phases.

After the project is finished, what will the project's legacy be?

Quattrone: Although the project itself will end in March 2019, we were lucky enough to receive funding from the Italian Ministry of Health to continue our research. During this next phase, we plan to study a wider biomarker discovery platform in human samples, the functional mechanism of EVs in respect of motor neuron degeneration, and how to inhibit particularly deviant EV from spreading.

EXITALS

- Coordinated by the University of Trento in Italy.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/752470

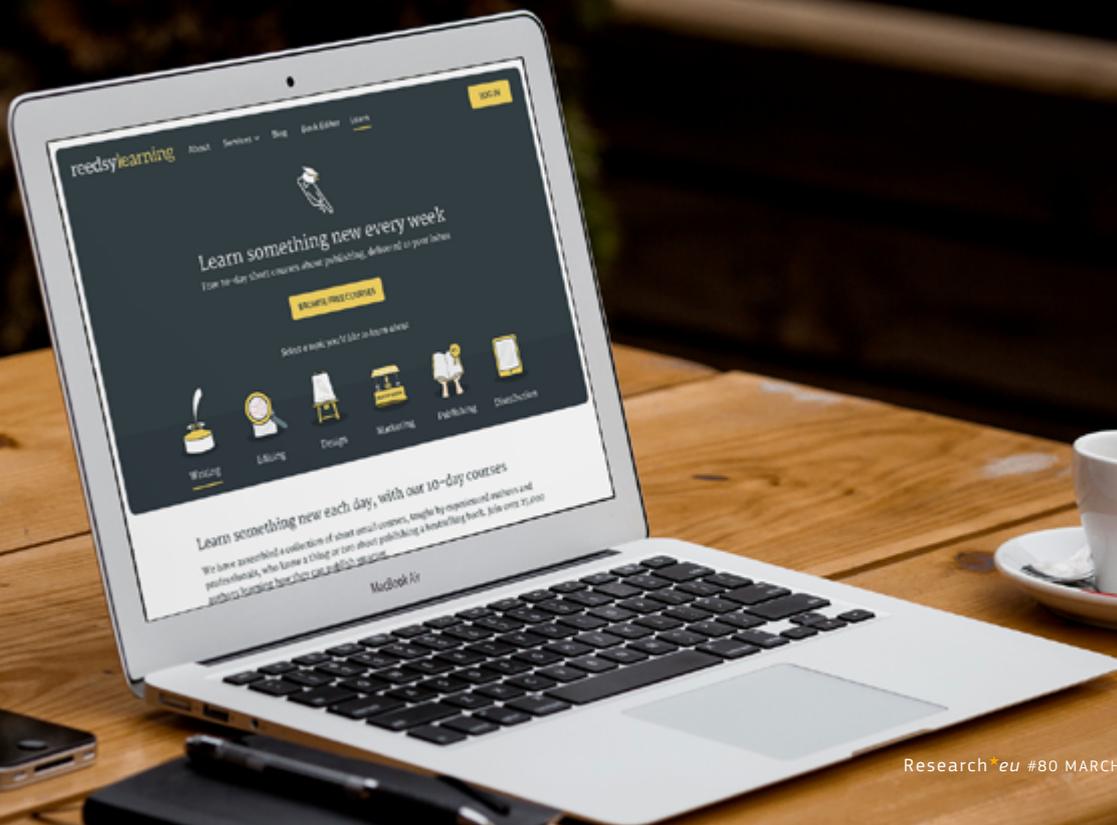


A new platform to help writers and publishing professionals come together to create beautiful books

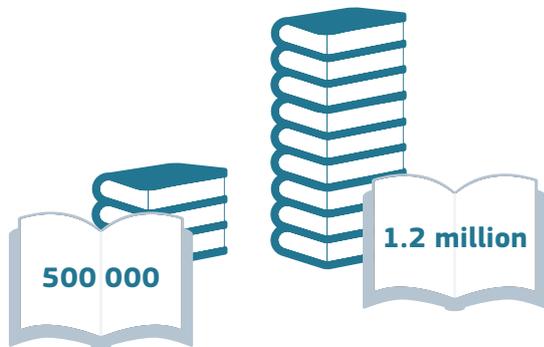
Anyone thinking of self-publishing their book should build a team around them to create a high-quality book. One EU-supported project has developed a curated marketplace to help authors find the industry's best editors, designers and marketers.

Back in 2014, Mr Emmanuel Nataf could see that while it had become very simple to distribute a book via the Kindle Store, self-publishing a high-quality product that had a chance to compete with titles published by larger publishers remained a real challenge.

“We could sense that the self-publishing market was growing massively and was becoming the best option for authors looking for better royalties and more creative freedom. In fact, according to Bowker, the market went from 500 000 self-published books in 2013 to 1.2 million books in 2017.”



The market went from
500 000 self-published books in 2013
 to **1.2 million** books in 2017



As the number of self-published books climbed, the freelance economy started to gather pace. More and more publishing professionals were available to provide their services as freelancers. “With these two trends happening concomitantly, we felt like there was a real opportunity to build a freelance marketplace for the book publishing industry,” so Nataf set up the Reedsy (Connecting authors and publishers with the world’s best publishing professionals to create high-quality books) project, with help from the European Union, to create a platform to bring writers and industry professionals together.

The Reedsy ecosystem comprises of their marketplace, a learning platform with over 30 free publishing courses, a book production tool and a number of additional tools authors can use throughout their publishing journey, including writing prompts.

More recently, Reedsy also launched Reedsy Discovery, a marketing platform for authors looking to reach their audience. The platform is generating a lot of interest; already over 150 000 people have registered. “We are really looking to offer writers a whole range of expert services to ensure they can publish their book successfully.”

“We are really looking to offer writers a whole range of expert services to ensure they can publish their book successfully.”

Nataf, Reedsy’s CEO, credits the diverse skill-set of the co-founding team, with their expertise in business-to-business and engineering, for the platform’s success. Since November 2018, Reedsy has been getting about 300 000 unique visits a month on its site, two-thirds of which come from Google search queries. “Since we found out that content was a real growth driver for us, we’ve been doubling down on it and grew the team accordingly. We’re now the second largest site in the writing/self-publishing niche.”

So what is next for the Reedsy team? Nataf says he is proud that Reedsy is not just a fast-growing business making money, but also a business that helps more people bring their ideas into the world through their books. “To further that, we are setting out to build a powerful engine for authors to increase their audience and for readers to discover the indie world,” which, Nataf feels, is still being ignored by mainstream publications.

“Our objective is to grow Reedsy Discovery into a community of millions of readers, and that is our next big challenge!”

REEDSY

- Coordinated by Reedsy Limited in the United Kingdom.
- Funded under H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/734046
- Project website: reedsy.com

Transnational activities of far-right nationalist organisations

The operations of far-right nationalist organisations often involve activities and collaborations that transcend national borders. Research funded under a Marie Skłodowska-Curie (MSC) Individual Fellowship combined historical and ethnographic data to explore the processes involved in these interactions.

The Transnat_farright (Transnational nationalism. Far-Right Nationalist Groups in East Central Europe in the 20th and 21st centuries) project studied how transnational networks of youth far-right nationalist organisations in Central Europe operate. “Being a nationalist activist often entails transnational cooperation and exchanges, aimed both at strengthening one’s national movement or organisation and at supporting a transnational community of like-minded people,” says project fellow Dr Agnieszka Pasięka.

Transnat_farright endeavoured to fill a gap in scholarship related to this aspect of far-right activities. Project research demonstrated the value of interdisciplinary dialogue and underlined the need to consider the historical dimension in analysis of the contemporary far right. The particular approach also emphasised the importance of including ethnographic methodology in such research.

THE NUANCES OF PRESENT-DAY FAR-RIGHT ACTIVISM

Project research was based on three main premises. Rather than studying far-right groups separately and then comparing them, Dr Pasięka explored relations and exchanges between different groups. Here, “Transnat_farright sought to understand the processes through which various nationalist – collective and individual – actors imitate, inspire, but also constrain each other.”

The fellow then related present-day developments with similar phenomena in the 1920s and 1930s. Considering the patterns of far-right cooperation in that period, the focus was on “examining to what extent the 1930s, broadly understood, constitute a source of inspiration for present-day activists.”

Finally, the research focused on movements and organisations that are not political parties per se, and which attract youth. Dr Pasięka underlined the importance of learning more about these actors and how they influence related sentiments and activities.

HISTORICAL AND ETHNOGRAPHIC RESEARCH

Ethnographic study of the far right is not without its difficulties. “That’s why in my project I combined ethnography of contemporary far-right movements with archival research on far-right nationalist actors active in the 1930s,” Dr Pasięka explains.

To compare present-day developments with those in the 1930s, archival research took place in Vienna, Warsaw, Lviv (a Polish city until 1939) and Trieste. These cities were multiethnic before World War II and therefore proved interesting venues for investigating the extent of



transnational-nationalist orientation of various nationalist activities.

Fieldwork was carried out in Italy and Poland, and in a southern part of Slovakia inhabited by the Hungarian minority. The fellow first had to establish contacts and gain or negotiate access to relevant groups and settings. Fieldwork then involved participant observation at various events organised by far-right groups, from big festivals and demonstrations to small-scale socialising events.

NEW INSIGHTS AND FUTURE AVENUES

Project findings have been presented at numerous international conferences and workshops in Europe and the United States.

They offer new insights into the subject and complement existing studies that tend to focus on political parties and rarely apply an ethnographic methodology.

In the 2017 publication 'Taking far-right claims seriously and literally: Anthropology and the study of right-wing radicalism', Dr Pasięka tackles a series of methodological and ethical problems entailed in studying the far right. For example, in the paper she discusses the question of how to render a fair picture of research participants even when in disagreement with them.

The fellow will draw on experiences gained in this fellowship in a new project: Living right: an anthropological study of far-right activism. Although still focused on transnational exchanges, this research will be primarily related to various civic activities undertaken by far-right actors.

TRANSNAT_FARRIGHT

- Coordinated by the University of Vienna in Austria.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/656377

SOCIETY

What the popular craze for Dickens at the turn of the last century can teach us today

What can the impact of the theatrical adaptations of the novels of Charles Dickens teach us today about how a cultural phenomenon sweeps across continents? A Marie Skłodowska-Curie fellow looked into copyright issues, artistic control and popular crazes to shine an intriguing light on creative endeavour today.

Game of Thrones, watched by millions in cultures across the world, its viewers vastly out-numbering the readers of the books behind the series, is a cultural phenomenon of our time. Travel back 150 years and the George R. R. Martin of the period was Charles Dickens. Although his viewing numbers were far lower, it was the dramatic adaptations of the books, then as now, that drew audiences in their droves wherever they were performed. The media may be different: the mechanism is the same.

So, what is the impact of such shared 'story telling' on diverse cultures? How can the adaptations of the past shine a light on current copyright issues? What can be learned when it comes to bringing Dicken's dramatic work to a new generation of audiences? These are just some of the questions research, conducted under a Marie Skłodowska-Curie fellowship, set out to answer.

"What we discovered during the course of the project," says the principal investigator of the Adapting Dickens (Dickens,



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Adaptation, and the Nineteenth-Century European Theatre) project, Prof. Thomas Betteridge, “is that Dickens’ novels were turned into plays and performed across Europe.” This wide adaptation of Dickens’ work threw up issues relating to copyright which resonate today – for example how to stop staged adaptations being mounted in America before the actual books were printed. “In Dickens’ day the new technology threatening artistic ownership was the telegraph, today it is the internet,” says Prof. Betteridge.

But it’s not all about copyright. The project, explains Prof. Betteridge, also considered what adaptations are most appealing to modern-day audiences and how adaptations could be used in teaching. Prof. Marty Gould, who worked on the project alongside Prof. Betteridge, created a range of materials to help teachers use adaptation as a pedagogical approach when teaching Dickens.

Prof. Gould will be further developing this side of the project’s work at the 2019 NEH Summer Seminar on “Reimagining Jane Eyre and Great Expectations: Teaching Literature through Adaptations.” This brings together 16 school teachers from across the US to study together for three weeks, with a focus on using adaptations (film, theatre and fiction) to teach.

As part of the research, Adapting Dickens conducted a workshop at Normansfield. “In particular we staged scenes from a play called a ‘Message from Mars’, which

was a loose adaption of a Christmas Carol. But it could also be seen as part of the pan-European interest in Mars that took place at the turn of the nineteenth century.”

Prof. Betteridge also staged the play ‘No Thoroughfare’ by Brunel University drama students, based on a short story adapted by Dickens and Wilkie Collins. “The students really enjoyed working on this play as it was highly melodramatic and therefore required them to work in a different way – in particular they could not perform this play in a naturalistic way since the characters were types.”

Prof. Betteridge is currently working with his colleague Prof. Gould on a paper on copyright and the lessons Europe can learn from Dickens’ struggles. “We also plan to build on the networks we have established with European scholars through this project to put together a pan-European project on the ‘Mars Craze’ of c. 1900.”

ADAPTING DICKENS

- Coordinated by Brunel University London in the United Kingdom.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/659461
- Project website: martygould.com/research



Smart analytics helping to ease traffic snarl-ups in urban mobility

Building a smart, integrated, technology-based system to make traffic more efficient is the key when it comes to dealing with road congestion and urban mobility. An EU-supported project is exploring ways of harnessing powerful algorithms to predict and manage urban mobility.

The SOUTHPARK (SOcial and Universal Technology Help-ing to detect ARrivals via sdK) project, based on the predict.io system, is a Software Development Kit (SDK) which can be integrated in any kind of app, and also in smart cars or trains. Throughout the project, many different cases that either use the real-time information of the detection or go in the direction of business intelligence using aggregated data were identified.

Rendering processes such as, among others, parking payment automation, capacity planning for public transport, car sharing and rental bikes, handicapped guiding systems, and commuter travel analysis, means that the SDK stands to reduce bottlenecks in traffic systems. The project initially set out to cover issues relating to parking

through their app 'ParkTAG', but broadened their scope as their work developed.

Project coordinator Ms Sandra Kobel says, "Current customers integrate the SDK into their apps, which allows them to gather location data on their user base. With this data, they are able to analyse the behaviour of their users (e.g. a parking app wants to know where people that have their app park and move) or trigger an event when something happens (e.g. remind a user to stop paying the parking meter when they've driven away from their spot)."

Through self-adapting algorithms, the predict.io SDK is able to detect the start and stop of any movement, either through an app or integrated in an IoT device. The

“ Our algorithms reduce the adaptation costs and time for localising to new settings by an estimated 75 % in comparison to the state-of-play when the project launched in 2015. ”

development of a system that self-adapts quickly to new local settings was key to the SOUTHPARK project. To integrate the SDK with its STOP detection technology in various different mobility apps, the main indicators are location precision, time precision, detection delay, battery discharge, minimum precision and minimum recall. predict.io sees the requirements for STOP in several mobility-related use cases.

While other systems exist, the algorithms in SOUTHPARK's SDK can very quickly self-adapt to new local settings, for example if integrated in a new app and/or in a new city or region. This, explains Kobel, was the machine learning part of the SOUTHPARK project. Being able to use a pre-existing system developed by predict.io saves developers time and money. "Our algorithms reduce the adaptation costs and time for localising to new settings by an

estimated 75 % in comparison to the state-of-play when the project launched in 2015."

The reduction in cost and the speed boost have obviously been appreciated by developers. "When the SOUTHPARK project ended in July 2018, the SDK and analytics suite had been successfully launched across a variety of countries and were producing around 75 million data points a day," says Kobel.

SOUTHPARK

- Coordinated by predict.io in Germany.
- Funded under H2020-SME and H2020-TRANSPORT.
- cordis.europa.eu/project/id/674119
- Project website: predict.io

TRANSPORT AND MOBILITY

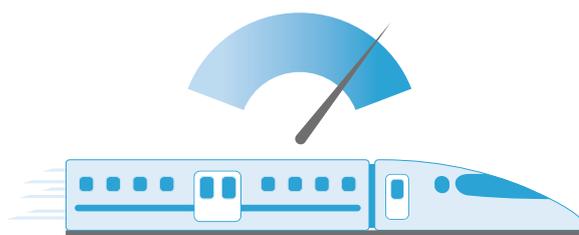
Customised solutions to improve railway productivity

Just over 4% of the EU's rail lines are 'high-speed' (above 200 km/h), meaning the continent's wide geographical reach is served mostly by conventional rail lines. An EU-funded consortium has identified and developed a range of low-cost technologies suited to railways with low utilisation but major potential for improvements in productivity.

The Horizon 2020 NeTIRail-INFRA (Needs Tailored Interoperable Railway) project worked to identify and develop railway infrastructure and monitoring technology for Europe's lesser-used lines. "While secondary lines are often economically marginal, may be at risk of closure or require substantial public subsidies, they often provide important public services," project coordinator Dr David Fletcher explains. They link communities, and provide access to jobs, education and healthcare.

As such, the project's main objectives were "to understand which are the optimum technologies to be used for different types of railway lines," says project manager Dr Jonathan Paragreen in a project overview video. "The types of lines used in the project include freight-dominated routes, busy commuter lines and also lesser-used, under-utilised passenger lines," he adds.

Just over **4%** of the EU's rail lines
are **'high-speed'** (above 200 km/h)





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ALL SYSTEMS GO FOR RAILWAY RENEWALS

Project researchers conducted a lean analysis for switch installations in Celje, Slovenia and Kayseri, Turkey. “The objective was to apply the lean techniques to railway renewal operations to better understand their strengths and weaknesses,” Dr Fletcher notes. Recommendations based on the outcomes of this analysis relate to improved planning and marking of components to ensure that tasks are completed right the first time.

Partners modelled transition zones between ballasted track and structures such as bridges and tunnels to understand the benefits of varying sleeper mass. The team validated simulations of this innovative approach against measurements from a transition zone in Portugal. As stated in the project’s ‘Final Brochure’, “to use heavier sleepers in the transition zone will result in lower displacement [and] settlement,” and thus “less maintenance (tamping and grinding) is required. Also, the life of the rail assets lasts longer (fewer renewals).”

Based on industry-supplied data and a wider literature review, NeTIRail-INFRA devised a simple flow chart to help infrastructure managers identify the lubrication most suited to their lines and traffic. This can be tailored to geographical location and line type.

TRACKS AND SYSTEMS FOR OPTIMAL SPEED

NeTIRail-INFRA evaluated the stability of a simple trolley wire system for mainline use. Although it is more common in tramways, the brochure notes, “the trolley wire system was shown to be stable for vehicle speeds of up to 100 km/h.” This potentially makes it suitable for some of the lesser-used commuter lines studied in this project.

“*Cost-benefit and societal impact analysis has validated the benefits of the developed innovations and their suitability for different line types.*”

Advances on an axle box acceleration system for monitoring track condition were demonstrated on an in-service passenger vehicle in Romania. Tests with speeds ranging from 20-220 km/h and over identified defects, and the system was shown to be suitable for metro, conventional and high-speed railways.

Project partners also developed and demonstrated very low-cost, self-powered monitoring equipment for electromechanical interlocking systems still used for lower-density lines. The solution allows transmission, logging and central monitoring of certain aspects of these systems’ status.

ECONOMIC AND SOCIAL BENEFITS

Partners have developed a web-based decision-support tool that encompasses all project learnings and allows users to implement cost-benefit evaluations and societal analysis. This “can be used by infrastructure managers across Europe to assess which are the most appropriate technologies developed within the project to suit their particular railway lines,” Dr Paragreen states.

To evaluate the impacts of project innovations, NeTIRail-INFRA surveyed and analysed feedback on passenger journeys on its case study lines in Romania, Slovenia and Turkey. “Cost-benefit and societal impact analysis has validated the benefits of the developed innovations and their suitability for different line types,” Dr Fletcher concludes.

NETIRAIL-INFRA

- Coordinated by the University of Sheffield in the United Kingdom.
- Funded under H2020-TRANSPORT.
- cordis.europa.eu/project/id/636237
- Project website: netirail.eu
- ▶ bit.ly/2CVnTn8

Behaviour data for airport management

Travelling to, from and through airports is a huge component of total journey time, yet until now no one has known how long these segments take.

The EU has mandated that, by 2050, European air travel must achieve door-to-door travel times of under four hours. Meeting the target will require integration of all transportation segments.

Yet a lack of fundamental information makes effective change difficult. Passenger behaviour – including movements within airports, and travel to or from – affects flights, while air traffic management decisions affect passengers. The specific impacts in both directions are relatively unknown.

Gathering the necessary information is difficult. Surveying passengers is both impractical and biased. Additionally, public data sources are often aggregated too coarsely. Thus the information gap persists, and management

decisions are taken blindly without understanding of the effects on passengers.

BIG DATA

The EU-funded BigData4ATM (Passenger-centric Big Data Sources for Socio-economic and Behavioural Research in ATM) project addressed the problem. “Our study used new geolocated data sources, in combination with more traditional information, to detail passenger movements and other behaviour,” explains Mr Pedro García, data scientist for Nommon Solutions and Technologies. The new sources included data from mobile phones, credit cards and Google Maps. All personal information was fully anonymised and blended in accordance with ethical guidelines. The ultimate purpose was to determine whether such information could inform decisions about air traffic management and public transport infrastructure.

The project delivered a set of research methodologies that utilise the new data sources to document airport catchment areas. Researchers validated the techniques against conventional data, and proved the project’s concept. The new data sources do provide continuous data of sufficient quality and resolution, yet at a fraction of the cost of conventional methods.

“*The methods we have developed have a huge potential for the planning and management of transportation systems.*”



PASSENGER BEHAVIOUR

The first of four case studies addressed total travel times, including the leg-by-leg breakdown. The information will prove useful in assessing the integration between transportation segments. “We found that current air-travel networks are far from achieving the EU’s four-hour goal,” says Mr García.

A second case study used credit card information to assess the impact of air traffic disruptions on passenger expenditure and travel times, in the Madrid airport area during May 2011. Disruptions caused identifiable patterns of expenditure, such as accommodation and alternative transportation. The investigation also determined that strike-related delays lengthen travel times, especially in the through-airport journey segments.

Case study three examined the competition between air-transportation and high-speed rail. The study concluded that access and exit times for airports and railway stations are important factors in the comparison.

Finally, the team used mobile phone apps data to study the competition among airports in the Greater London area. The study predicted likely changes emerging from

a proposed high-speed London-Birmingham rail link, expected to bring Birmingham airport into the London catchment and thus take market share from minor airports.

“The methods we have developed have a huge potential for the planning and management of transportation systems,” says Mr García, “including airport operations and the provision of new mobility services for airport access/egress.” The entire transportation sector – including operators, public authorities and consultancy firms – represents potential customers.

The project’s new methods allow direct study of the issues affecting air transportation. The information will help the entire system evolve to meet passenger needs.

BIGDATA4ATM

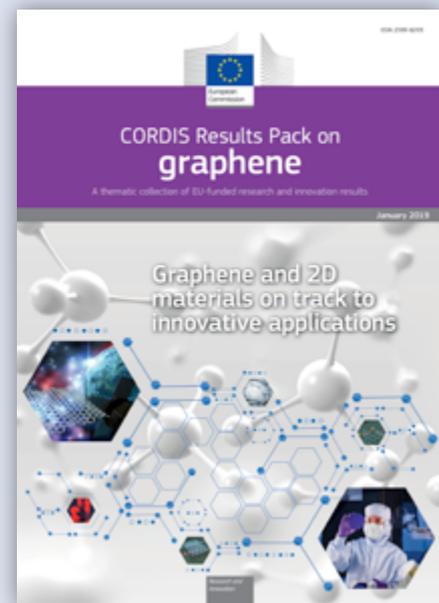
- Coordinated by Nommon Solutions and Technologies SL in Spain.
- Funded under H2020-TRANSPORT.
- cordis.europa.eu/project/id/699260
- Project website: bigdata4atm.eu

GRAPHENE is the thinnest known compound (at one atom thick!) but also the strongest ever discovered – between 100 and 300 times stronger than steel. Graphene will be a key industrial technology in the twenty-first century and Europe is investing big.

This is why we invite you to explore our recent **CORDIS Results Pack** on this incredible material, featuring seven articles on the EU’s **Graphene Flagship**, the EU’s largest research initiative with a budget of EUR 1 billion.

As well as its focus on the Flagship, our Pack also includes additional articles on how graphene development and research is being pursued within other EU funding programmes, including the European Research Council (ERC) and the Future & Emerging Technologies (FET) programme.

Browse, download or order this Pack on our website at:
cordis.europa.eu/article/id/401207





Nano-scale clusters shed light on the fate of aerosols

Aerosols are quite ambivalent: they play a critical role in cloud formation, indirectly work in opposition to greenhouse gases, but are also a source of pollution and have a – still largely unknown – influence on climate change. Research under the nanoCAVa project aimed to clarify this matter with a focus on cluster formation.

When it comes to aerosols and their impact on the environment, the first thing that comes to mind is often the ban on ozone-depleting chemicals (CFCs) in the 70s. Whilst these chemicals are long gone, other aerosols are still used and released in the atmosphere worldwide, and the truth is there is still much we don't know about their impact on the environment.

As Dr Katrianne Lehtipalo, from the University of Helsinki's Institute for Atmospheric and Earth System Research, explains, "there is a large variability in both the sources (natural and anthropogenic) and properties (concentration, size, composition, etc.) of aerosol particles, which makes it difficult to accurately model their impacts on clouds and climate. We need to know more about how aerosols are formed and how they transform in the atmosphere."

This was the mission at the heart of the nanoCAVa (Formation of nano-scale clusters from atmospheric vapors) project. Over three years and with help from research groups at the University of Helsinki and the Paul Scherrer Institute, Dr Lehtipalo aimed to advance current understanding of the fine line between the gas and condensed phases of aerosols, by studying the formation of nano-scale clusters from atmospheric vapours.

“ Our results are among the first indicating how clusters and nanoparticles are formed almost everywhere in the atmosphere, from clean countryside to urban megacities. ”



“Our approach consisted in combining detailed laboratory studies, investigating the basic properties and formation mechanisms of aerosol particles in long-term field studies. This is a powerful combination, which allows us to use our expertise gained from years of atmospheric studies to plan lab experiments relevant to the atmosphere and current research questions. On the other hand, this allows us to test whether the mechanisms found in the lab and related models can explain real atmospheric observations,” Dr Lehtipalo says.

Thanks to recent breakthroughs in instrumentation able to detect atmospheric vapours, clusters and recently formed aerosol particles, the project team could measure clusters in the atmosphere and study their formation process in the CLOUD chamber at CERN.

Not even the aerosols with the lowest atmospheric concentrations could escape these detection methods. The team now have a better understanding of the concentrations and composition of sub-3 nm clusters in the atmosphere; and they could even find new formation and growth mechanisms of aerosol particles – notably sulfuric acid, ammonia, amines and organic vapours.

“Our results are among the first indicating how clusters and nano-particles are formed almost everywhere in the atmosphere, from clean countryside to urban megacities. Their sources and concentrations are of course varying a lot, and we hope to get more insight on that in the future, as well as to understand better what controls the growth of the clusters to climate-relevant sizes,” Dr Lehtipalo explains.

Although the project has now come to an end, the team intend to continue their work. New field measurements are currently ongoing in different parts of the world, and additional lab experiments are waiting to be analysed. Dr Lehtipalo also points at the need for more robust and reliable instrumentation for long-term atmospheric measurements as, she admits, there are still many parts of the atmosphere we have yet to understand.

NANOCAVA

- Coordinated by the University of Helsinki in Finland.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/656994

CLIMATE CHANGE AND ENVIRONMENT

N₂-fixing bacteria can counter water deoxygenation, study finds

Recently spotted in deep low-oxygen waters, N₂-fixing bacteria have since then been suspected of playing a role in water deoxygenation – one of many consequences of climate change. It turns out not only that they do play a role, but also that it is a mitigating – rather than worsening – one.

Ocean deoxygenation is a widely-discussed consequence of climate change. But the evolution of its nitrogen budget is equally important. On the one hand, nitrogen is contained in excrement, fertilisers and fossil fuels: it

eventually ends up in rivers and oceans and feeds algae, and as these algae die and sink they deplete water's oxygen. But on the other hand, nitrogen feeds phytoplankton – making it an essential part of the ocean's food chain.



Dr Carolin Löscher, assistant professor at the University of Southern Denmark and coordinator of the NITROX (Nitrogen regeneration under changing oxygen conditions) project, believes that studying the few bacteria capable of fixing dinitrogen (N₂) gas is one of the keys to understanding the oceans' evolution, "There is still not much we know about these bacteria, their contribution to the 'N-budget' of the ocean, and how they feed algae with nitrogen resources."

Whilst researchers used to think these N₂-fixers could only be found in nutrient-depleted surface waters, she found evidence in 2014 that they were also present in Peruvian oxygen-poor deeper waters. "I suspected that N₂ fixation actually had a major role in controlling the rate of deoxygenation of oxygen-minimum zone waters. This would mean that whatever controls N₂ fixation in those waters would possibly control ocean deoxygenation altogether," explains Dr Löscher.

Through the NITROX project, Dr Löscher aimed to verify this hypothesis. She set out to identify which microbes were involved in N₂ fixation in oxygen-minimum zones

(OMZ) with dedicated molecular genetic methods, measure its extent and investigate its regulation and response to oxygen loss.

"Perhaps our most important finding was a feedback regulation between N₂ fixation, primary production by algae and cyanobacteria, and their degradation after they die and sink out of the surface water," Dr Löscher explains. "This means that oxygen-poor conditions favour N₂ fixation, in turn allowing algae to grow and resulting in deoxygenation."

This process would, in principle, cause oxygen-poor waters to continuously expand. But it's not the case, as NITROX

“ *Perhaps our most important finding was a feedback regulation between N₂ fixation, primary production by algae and cyanobacteria, and their degradation after they die and sink out of the surface water.* ”

demonstrates: the extreme anoxia due to hydrogen sulphide being produced actually stops N₂ fixation and, with that, its very production. “As a result, no more organic material is produced and exported, and oxygen consumption in deeper waters decreases. This is the first evidence of a feedback cycle driven by bacteria, which can counteract one of the consequences of climate change – namely ocean deoxygenation,” Dr Löscher enthuses.

The existence of such a mechanism, able to counteract climate change, is a game changer and shows once again the planet’s capacity to self-regulate. Whilst it doesn’t rule out the effects of human-made climate change, Dr Löscher believes it to be an eye-opener.

Although the NITROX project has now come to an end, Dr Löscher intends to follow up on her research with a

focus on other OMZ regions. “I would like to verify whether this could be a global or general phenomenon. Besides, I found indications of two more microbial feedback loops possibly mitigating OMZ expansion, and I will propose a large-scale project on the combined power of those feedback loops in the form of an ERC starting grant project,” she concludes.

NITROX

- Coordinated by the University of Southern Denmark in Denmark.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/704272



We want YOU to be our Project of the Month!

When reading through this month’s issue, you may have noticed that there’s no Project of the Month article this time round – this is because we received no submissions at all from projects setting out the reasons they should be featured, and admittedly we think it’s a shame.

We really want to hear from projects that have just accomplished something great, such as a fascinating new discovery or the advancement of a really innovative new technology. So if your project has just had a EUREKA moment, then contact us, as we’d love to feature you – the address is editorial@cordis.europa.eu Don’t hesitate to get in touch!



SPECIAL FEATURE

FROM ASIMOV TO ALL AROUND US: WELCOME TO THE ROBOT REVOLUTION

Editorial

‘You just can't differentiate between a robot and the very best of humans’

Isaac Asimov, ‘*I, Robot*’

Robots are a staple of science-fiction, with two of the most famous examples being the novel ‘*I, Robot*’ by the widely acclaimed Isaac Asimov, and Ridley Scott’s 1982 cinematic masterpiece ‘*Bladerunner*’, with a plot focused on a group of fugitive ‘replicants’, synthetic androids so advanced that they look, sound and act entirely like humans but with superior strength, speed and agility.

Another trope of the genre is the number of ethical questions that would abound from the rise of such anthropomorphic machines – would feeling, sentient robots be eligible to be granted the same social, economic and political rights as ‘real’ humans? How would social relationships between humans and robots evolve? What would be considered acceptable interaction and what would be taboo? Will large-scale automation of occupations previously held by humans actually happen and what would be the consequences for society? And, maybe most fundamentally of all, if we were able to manufacture beings that would be the real-life equivalent of the ‘*Bladerunner*’ replicants, will that then result in a substantial redefinition of what it fundamentally means to be human?

As fascinating as it is to ponder these philosophical conundrums, robotics research has not quite yet reached the point where we’ll need to grapple with them anytime soon. But as the projects covered in this month’s special feature show, it can be argued that humanity has definitely taken the first steps in that direction and that robots are starting slowly, but surely, to seep their way into our society. They are now seen as the solution for numerous challenges that we must face in the 21st century, from the need to care for an increasingly elderly population, to accessing harsh environments where humans

cannot tread, to even relieving us from the most menial tasks, such as scrubbing floors (all three of these examples are specifically covered in the following pages).

Japan and South Korea are often the first countries that come to mind with regards to robotics expertise. But the EU is also taking advanced research in this field extremely seriously. Indeed, Europe is one of the world-leading regions in industrial robotics with a share of around 32% of supply and use. Europe’s share in the world service robotics market stands at around 63% due to the continent’s excellence in interdisciplinary research in ‘intelligent robots’.

Robotics research can be found throughout many of the Horizon 2020 work programmes, and then there is SPARC, the dedicated partnership for robotics in Europe that aims to maintain and extend Europe’s leadership in robotics in all sectors of society, science and the economy. With EUR 700 million in funding through 2014-2020, SPARC is the largest civilian-funded robotics innovation programme in the world.

From 20-22 March 2019, SPARC will host its annual European Robotics Forum in Bucharest, Romania, showcasing the very best of Horizon 2020-funded European robotics research. Whether you can be there in person or not, we invite you to get a taste of these innovations in our dedicated special feature where we hope you’ll realise that really, the robot revolution has truly just begun...

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

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Advanced robot provides assistance at home to older persons in need

Deteriorating demographics challenge the ability to provide the elderly with care services at home. An EU initiative has addressed the issue by creating an innovative robot to assist those suffering from mild cognitive impairments and dementia.

The old-to-young population ratio in modern societies is increasing. This progressively hinders the capacity to provide proper caregiving services to older persons in their daily life at home. Service robots could help in this regard and share some responsibilities with human caregivers.

The EU-funded RAMCIP (Robotic Assistant for MCI Patients at home) project researched and developed a new service robot to support the elderly with mild cognitive impairments and early Alzheimer's disease in their daily activities at home. RAMCIP focused mainly on the "development of a robot with high-level cognitive functions that enable proactive and discreet robot behaviour," says project coordinator Prof. Dimitrios Tzovaras. "The project developed the robot in order to support a series of use cases including assistance provision for daily activities such as cooking, eating and medication as well as securing safe handovers."

Project partners successfully tackled such key issues as the provision of proactive, discreet and optimal assistance to the user. To facilitate this, they implemented advanced communication channels between the user and the robot. They also applied state-of-the-art means for physical interaction between the robot and the patient's home environment.

“RAMCIP outcomes will stimulate robot users' socialisation, positive outlook and cognitive training.”

The robot's high-level cognitive functions orchestrate a combination of advanced lower-level mechanisms. These enable the robot to communicate with the user, and to establish dexterous and safe manipulations.

RECOGNISING HUMAN ACTION AND BEHAVIOUR PATTERNS

The researchers developed novel methods for unobtrusive human activity recognition. This was done to allow the robot to identify complex human actions and the behaviour of multiple persons in the user's home. The resulting inferences help with the robot's successful execution of daily activities like cooking and housekeeping, detecting crucial forgotten actions, and emergency cases such as falls.

Patient-robot communication is based on touchscreen, speech and gestural modalities. The technology incorporates an augmented reality display and an underlying empathic communication channel. These innovations permit the robot to sense the effect on the user and to moderate it.

STEP-CHANGE IN ROBOTICS FOR ASSISTED LIVING

The robot is able to safely grasp a variety of objects in the home environment, ranging from very small items to dishes and cooking utensils. It interacts with home objects or appliances, such as doors, light switches and ovens. The robot can also fetch objects that can't be reached by the user.

The researchers demonstrated the robot at two major exhibitions in Europe after the project finished. Live demonstrations continue to take place. They are currently looking into ways to commercialise the service robot.

"RAMCIP outcomes will stimulate robot users' socialisation, positive outlook and cognitive training," he explains. These aspects are considered important factors in facilitating the improvement of older individuals' quality of life.

"Thanks to the RAMCIP robot, patients with mild cognitive impairments or early Alzheimer's disease will be able to live longer and more independently at their own homes," concludes Prof. Tzovaras. "This will help to reduce their dependence on the human caregiver, time spent in hospitals and institutionalisation."

RAMCIP

- Coordinated by CERTH in Greece.
- Funded under H2020-HEALTH.
- cordis.europa.eu/project/id/643433
- Project website: ramcip-project.eu/
- ▶ bit.ly/2TNBN03



State-of-the-art robot to better assist search and rescue operations in low-visibility conditions

The presence of smoke, dust or fog at disaster sites limits the use of robots in relief operations. An EU initiative has developed technology that allows robots to operate in areas severely lacking visibility.

Robots play an increasing role in providing support at disaster sites. However, sensor technology and the related cognitive approaches available to date can't cope with situations where visibility is impaired due to smoke, dust or fog. This significantly limits the robots' value in such scenarios.

The EU-funded SmokeBot (Mobile Robots with Novel Environmental Sensors for Inspection of Disaster Sites with Low Visibility) project was "primarily driven by application needs for robots that operate in domains with limited visibility," says project coordinator Prof. Achim Lilienthal. It focused on civil robots that support fire brigades in search and rescue missions such as post-disaster management operations in response to tunnel fires. "The ultimate aim was to provide solutions in terms of both hardware and software for environments with restricted visibility."

SmokeBot addressed this challenge by delivering software and hardware components that facilitate robot systems in performing under harsh smoke, dust or fog conditions. The

project team achieved this through sensor fusion, where the outputs of the robot's novel 3D radar camera, stereo thermal camera and gas sensors are integrated, interpreted and used by the robot.

SENSOR TECHNOLOGY FOR OPTIMAL INSPECTION IN ADVERSE CONDITIONS

Specifically, the researchers developed gas sensors designed for use on mobile robots and tuned to detect harmful gases that may be present in disaster situations. This helps to assess the distribution of such hazards and to warn and protect rescue staff. Suited also for low-visibility environments, the sensors enhance the cognitive abilities of mobile robots.

The scientists created a set of algorithms, including approaches for robot localisation in low-visibility scenarios, and for airflow and gas distribution mapping in the presence of unknown gases. They devised a method with which a robot can relate a pre-existing map of the environment to its own perception. This enables the operator to indicate where the robot should go, even if it hasn't been to that place before.

Team members integrated the project results into a prototype for a commercial low-visibility explorer robot to support emergency services. They successfully demonstrated the prototype at a firehouse in Dortmund, Germany.

REDUCING THE RISK OF SAVING LIVES

SmokeBot showed that robots can be very useful in civil applications under low-visibility or toxic conditions, where human lives would otherwise be put at risk. "The most important impact is that it enables the use of robots instead of human operators in certain situations," Prof. Lilienthal stresses. "It isn't a job killer – we built the robot to help firefighters, not replace them."

© Achim J. Lilienthal



“By improving the abilities of robots to support emergency services, therefore increasing the safety of rescue staff and ultimately citizens, SmokeBot has brought about a step change in robotics.”

Now that the project has ended, the sensor technology will result in new products to be brought to market. In addition, the software will be made available as open source.

“By improving the abilities of robots to support emergency services, therefore increasing the safety of rescue staff and ultimately citizens, SmokeBot has brought about a step change in robotics,” concludes Prof. Lilienthal.

SMOKEBOT

- Coordinated by Orebro University in Sweden.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/645101
- Project website: smokebot.eu

COMAN+ takes human-robot interaction to the next level

Imagine a humanoid robot able to help industry workers carry heavy objects around or to assist doctors in their physiotherapy sessions. Such versatile robots will soon be a reality thanks to work under the EU-funded CogIMon project.

Playing a ball game and moving furniture may seem like two completely different tasks, but they have a couple of things in common. First, it's easier to do it together. Then, these seemingly undemanding tasks actually require a subtle combination of strength, moderation and synchronisation. Try playing with a ball or moving a table with a robot, and you'll see how difficult this actually is.

There is one humanoid robot, however, that might soon be able to overcome this difficulty. COMAN+ – an evolution of the COMAN humanoid developed under the earlier FP7 AMARSi project – is presented by its creators as a cheaper, robust and versatile humanoid capable of executing everyday tasks.

Prof. Dr Jochen Steil, coordinator of CogIMon (Cognitive Interaction in Motion), discusses the most important project outcomes shortly before its completion in May.

What type of collaborative human behaviours did you aim to replicate with this project and to what end?

We focused on behaviours that require the understanding of applied forces and the implicit communication they require.

These include joint manipulation of objects (carrying tables, joint lifting of heavy objects) or mutual throwing and catching, because in these situations, forces are estimated from



the movement. Another example is the force coupling of joysticks in a game, where players implicitly learn from each other through force-based communication.

How could mastering these behaviours be a game changer for industry?

Understanding forces is fundamental for physical robotic assistant systems, which actively support the human through regulating their strength according to human capabilities and the task at hand.

This goes beyond using compliance for safety only: it allows for more sophisticated and human-friendly action, which will be a must for the next generations of assistive robotics. Humans' applied forces display large variations even in repetitive tasks and therefore a 'one-size-fits-all' controller will not fit the bill in physical interaction. Assistance robots will need to actively control their strength for smooth, ergonomic and effective interaction.

Why did you focus on the COMAN robot specifically?

Humanoid research is the decathlon of robotics: it requires the integration of many fields and different expertise to tackle one big technological and scientific challenge that promises major advancements. It is a fascinating and demanding field that naturally attracts many best-in-the-class researchers and requires joint efforts, notably under EU-funded initiatives.

COMAN is one of these European success stories whose development was significantly funded through EU research frameworks. It is torque-controlled and features springs in its body, so that it can act safely in human-robot interaction and actively regulate its full-body compliance. With its advanced actuation technology, it is one of the first and best humanoid robots to do so.

This story continues in CogIMon through the development of COMAN+, the next generation of humanoid robots that will be more robust, cheaper, versatile and capable of executing everyday tasks.

What would you say were the project's most important achievements?

There are both scientific and technological achievements. Scientifically, CogIMon advanced the current understanding of human interaction in motion, which is mostly driven by our partners in human motion science. This has led to new models of how humans learn to control forces in interaction, which are now implemented in robot controllers as well. Besides, the state-of-the-art in compliant control for humanoids, multi-arm and multi-leg systems was strongly advanced.

Technology-wise, the scaled-up humanoid robot COMAN+ strengthens the world leading position of European research in the development of variable impedance actuation and compliant humanoid robots. We have also developed engineering tools for simulation and control of such robots and made them open source. Finally, we have



Prof. Dr Jochen Steil
Project coordinator of CogIMon
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“ *Humanoid research is the decathlon of robotics: it requires the integration of many fields and different expertise to tackle one big technological and scientific challenge that promises major advancements.* ”

created the technology to run robot controllers in VR and open new avenues for mixed-reality applications.

How did you proceed to demonstrate these technologies?

CogIMon has demonstrated for the first time two humanoid robots carrying objects together. The project has also shown how four compliant robot arms can collaborate to lift and move a heavy object in interaction with a human, devised new methods for soft robot catching, and created workpieces which have been finalists twice for the Kuka Innovation Award at the Hannover fair. Finally, we have developed a very promising application in physiotherapy, where virtual reality and robot control are combined to enable ball-catching training for patients.

We are going to demonstrate COMAN+ and these applications to the public and scientific community in the upcoming ICRA exhibition.

What's been the feedback from industry so far?

Most of CogIMon's work is rather fundamental and our humanoid robots are still far from making it into industrial applications. There is a lot of interest, but little direct feedback from concrete use cases.

However, successful participation in the innovation awards and the demonstration of advanced algorithms for compliance control have generated a lot of attention. The actuation units developed for COMAN+ are currently commercialised, and the first evaluation studies with real patients are being conducted for our physiotherapy application. The VR-robotics mixed-reality approach has also resulted in a new collaboration with an SME.

What are your follow-up plans?

We will focus on applications in healthcare and physiotherapy, and ergonomics, to further develop the combination of VR and robotics and enable safe physical interaction for training. This requires further advances in both hardware and engineering tools to allow for more coherent and systematic but flexible application development.

Follow-up research will also concern multi-robot applications, as well as the control of humanoid robots in everyday

tasks. The humanoid robotics decathlon will certainly continue in the years to come.

COGIMON

- Coordinated by the Technical University of Braunschweig in Germany.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/644727
- Project website: cogimon.eu/

An end to the mop and bucket, pass floor-cleaning duty to robots

Think of all the floors in public places you have walked across today: airports, supermarkets, stations, restaurants, there's a lot of surface area out there that needs cleaning every day. It's repetitive, takes time and often means cleaners have to work out of peak hours. So why don't we hand it over to robots?

Currently there is no robot that satisfies the requirements of professional users and cleaning services companies. Floor washing tasks are demanding in a variety of ways: the operation needs to be autonomous, areas have to be navigated precisely, the safety of people and goods has to be assured, and the robot has to be managed by cleaning staff and must be able to operate on-demand during opening hours. Other obstacles such as the presence of multiple robots working at the same time, and programming issues, all have to be taken into account.

An EU-supported project called FLOBOT (Floor Washing Robot for Professional Users) has developed a robot that

can take all these hurdles in its stride, and they've been trying it out at supermarkets, airports and public buildings.

Dr Panayiotis Philimis, CEO of CyRIC – Cyprus Research & Innovation Center Ltd, and FLOBOT project coordinator, explains why current options on the market don't meet the users' needs, "They're expensive and their operational speed and real automation and autonomy are limited."

FLOBOT is out to offer more. Dr Philimis points out that while other robotic cleaners focus more on the robotic side of things than on the cleaning, FLOBOT's consortium includes a major scrubber-drier manufacturer that can guarantee that the cleaning performance of the robot will be of the highest quality.

"The team also includes robotics experts, and their work made it possible to fully automate FLOBOT's operation, including functions proposed for the first time for such a machine, such as a docking station to fill-in the water tank, empty and clean the wastewater tank and recharge the battery." Their system includes novel safety features, including a system to proactively inform people about the robot's presence and intentions.

But what really makes Dr Philimis proud is that FLOBOT is expected to be marketed at a lower price than its competitors.



“Re-investing employee time in more crucial services also improves customer satisfaction and quality of services and will free-up people to do more interesting tasks.”

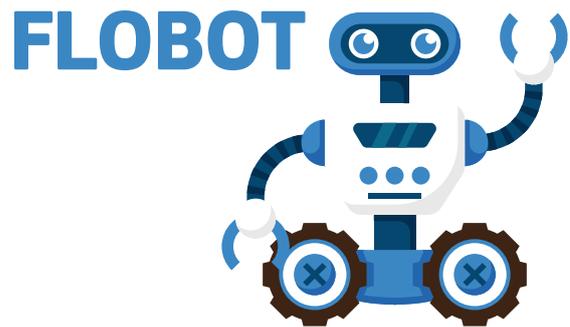
A TESTING TIME

Numerous tests took place during the project, in both controlled and real-world environments. The first tests took place in Verona, where the scrubber manufacturer (FIMAP) is based. These included autonomous missions in a simple, empty room and then more advanced tests in FIMAP's warehouse during working hours.

“There were people and machines moving around, and FLOBOT needed to operate efficiently and safely,” Dr Philimis explains. Once that worked, they moved to real-world demonstrations and pilot validations in four different sites.

The first group of such tests was organised in a Carrefour hypermarket, one of the project partners, in Carugate, near Milan. “We successfully tested the robot during operational hours and collected feedback and data for further improvements. Then, about a month later, we repeated the testing in the same location, with the updated modules.”

As the last step of the validation and qualification review, they organised testing weeks, during operational hours, in Lyon's Saint Exupery airport, at a nearby warehouse, and in a hospital. “All pilots were successful, allowing us to



can clean a surface at **4 km/h** and operate for at least **1.5 h** before it needs to refill the water tank

validate FLOBOT in different scenarios and conditions, while collecting data for further improvements,” says Dr Philimis.

“Re-investing employee time in more crucial services also improves customer satisfaction and quality of services and will free-up people to do more interesting tasks,” he adds.

FLOBOT

- Coordinated by CyRIC in Cyprus.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/645376
- Project website: flobot.eu
- ▶ bit.ly/2Jf4Q90

Safer human-robot collaboration for workplaces of the future

The next generation of robots could be entering the workplace alongside humans, but this first needs some collaborative principles to be established. SYMBIO-TIC has developed a system for such a safe, dynamic, intuitive and cost-effective working environment.

Factories of the future will depend on the development of safe, cost-effective, hybrid assembly/packaging arrangements based on human-robot collaboration. However, the European manufacturing industry faces implementation challenges, which could be summarised as a lack of: adaptability, flexibility and vertical integration.

The EU-supported SYMBIO-TIC (Symbiotic Human-Robot Collaborative Assembly: Technologies, Innovations and Competitiveness) project created tools for robot-reluctant industries where current tasks and processes are typically considered too complex for automation. These included: a collision avoidance system, a planning and control tool to

monitor and re-plan assembly tasks, intuitive robot control commands and a real-time worker support system, tailored to workers' competence and skill levels, as well as changing assembly sequences.

A SYMBIOTIC MULTIMODAL SOLUTION

When it comes to human-robot collaboration, there is a high initial investment, often a programming skills-shortage, inflexibility of pre-programmed robots within dynamic environments, and safety concerns. There is also no common standard or associated regulations, leading to the current safety-driven prohibition, of humans working closely with robots in a shared environment.

The SYMBIO-TIC team came up with their modular solution after analysing the human-robot collaborative assembly line and identifying the critical missing elements. As project coordinator Prof. Lihui Wang from the KTH Royal Institute of Technology in Sweden says, "When a worker walks onto a robotic assembly line, the first priority is safety. The second is treating the robot as a teammate. Finally, at the system level, the human-robot interaction must be monitored and coordinated."

SYMBIO-TIC's contribution provides a system that makes legacy industrial robots safe, smart and collaborative. "This approach

enables an easy entry for industries that are reluctant to explore human-robot collaborative working," says Prof. Wang.

Part of the system's strength is the inclusion of 'function blocks', each containing multiple algorithms associated with data and event inputs, which can then be used as inputs for subsequent blocks. This gives rigid control codes more flexibility and adaptability, such as being able to modify a robot's trajectory if a human approaches.

The team have already recorded active collision avoidance for worker protection and are currently developing a demonstrator, to be ready by mid-March 2019, which integrates all the modules and sub-systems together to showcase the full solution. This demonstrator will be located at Volvo Cars in Sweden, where it will assemble a mass balancing system (MBS) within a car, but outside of the regular production environment.

After this, the team will seek out new partners to advance the technology to a market-ready state.

SMART AGENTS

SYMBIO-TIC supports the increased competitiveness of European industries through these enabling technologies. More specifically, the integrated system will increase productivity by: shortening assembly lines, reducing the idle time



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“ This approach enables an easy entry for industries that are reluctant to explore human-robot collaborative working. ”

of workers/robots and introducing rapid robot control by voice, vision and haptics, avoiding the need for programming skills.

This envisions a future where assembly operators will be ‘smart agents’ working with robots in a coherent, effective team, naturally communicating and controlling their robot colleagues through speech, sign language and/or touch.

“We are working towards better environmental and social sustainability through energy-efficient robotic control and ergonomic work environments. The latter improves workers’ lives

and encourages gender equality, as female workers can also perform heavy-duty tasks, with robotic support,” says Prof. Wang. “Such smart agents, no matter their gender, height, age and physical strength, can do the same job efficiently.”

The system will also maintain product quality, with humans remaining ultimately responsible for inspections and the necessary adjustments.

SYMBIO-TIC

- Coordinated by the KTH Royal Institute of Technology in Sweden.
- Funded under H2020-LEIT-ADVMANU.
- cordis.europa.eu/project/id/637107
- Project website: symbio-tic.eu

Maintenance drones surpass existing alternatives at a fraction of the cost

The time when drones were only watching the world from above will soon be over. A new generation equipped with robotic manipulators promises autonomous operations at heights previously accessible only at huge cost and risk.

Pretty much anyone can buy their own drone today with a starting price of less than EUR 100. These aerial robots are inexpensive, easy to use, and bring happiness to professional video producers looking to spice up their products with stunning aerial views. But don’t think for a second that the technology is done surprising us: in fact, companies all across the world are already working on the next major drone applications.

The AEROARMS (Aerial RObotic system integrating multiple ARMS and advanced manipulation capabilities for inspection and maintenance) consortium is in the running. The premise of their project is simple: drones can go to places humans would have much more trouble accessing, and potentially perform very difficult tasks once there at a fraction of the cost. The drones are equipped with robotic manipulators which can improve the quality and frequency of inspection and maintenance activities while saving on major costs.

Let’s take the oil and gas industry for instance: a large refinery would usually have 40 000 km of pipes, requiring over 50 000 measurements to prevent corrosion and accidents. AEROARMS’ drones can not only fly to the most elevated structures, but also perform maintenance operations while

flying. The project’s AEROX system can, for instance, move a wheeled end-effector with ultrasonic sensors to determine the thickness of the wall of a pipe – which is very important for measuring corrosion and avoiding potential damage and accidents.

The drones are
10 times faster



than manned helicopters
and can reduce maintenance
bills by **25%**



© AEROARMS

Perhaps the most significant advantage is that having drones perform these operations is cheaper, faster and safer. According to Dr Anibal Ollero, project coordinator, the savings could reach EUR 700 000 per refinery per year. The drones are 10 times faster than manned helicopters and can reduce maintenance bills by 25% while avoiding accidents.

This is, of course, just an illustration of the drones' capabilities. They can be used to install surveillance sensors and communication equipment such as antennas in inaccessible sites or – as demonstrated by the University of Seville and the CATEC Aerospace Technology Center in the AEROBIO project – for the detection and evaluation of cracks in bridge pillars or piers, using ultrasonic sensors in the end-effector of their arm. “This is highly relevant when considering the EU's large number of road and rail bridges that are more than 50 years old, and the need for inspection and assessment of these bridges,” says Dr Ollero.

AEROARMS' most important breakthroughs include the aerial robots: two arms for dual manipulation; manipulation platforms with tilted rotors for omnidirectional motion, fully autonomous operation guided by environment perception including 3D lasers for mapping and cameras for visual servoing; and autonomous planning and reactivity with dynamic awareness. These innovations have generated many publications in prestigious robotic journals and conferences.

“Our most impactful innovation has been the development of the first drones able to perform contact inspection under aerodynamic and other unavoidable perturbations,” Dr Ollero explains.

For most operations, the drones will fly autonomously. A backup pilot can take control in case of emergency situations, whilst an inspector in the control centre can observe images provided by the on-board cameras, select the positions to be inspected or guide the sensor in the end-effector of the drone's manipulator.

The first AEROARMS products are expected to be commercialised shortly after the project ends in May 2019. From thereon, the consortium intends to pursue its R&D efforts to consolidate their leadership in the field.

AEROARMS

- Coordinated by the University of Seville in Spain.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/644271
- Project website: aeroarms-project.eu

Multitasking robots work hand-in-hand with operators

On a production line, every second counts and the last thing companies want is to waste valuable expertise on low-level tasks. ColRobot proposes a new generation of collaborative robotic systems specifically for the automotive and aerospace industries.

The automotive and aerospace industries share common challenges: huge backlogs of orders and a growing need for flexibility to meet market demands. Most of us have probably faced this problem when ordering a new car – we want to be able to ‘shop’ from a long list of options, and we can't wait for the dealer to call us and say that our brand-new

car has just arrived and is ready for pick-up. It's no different for the satellite industry.

So far, this need for more productivity and flexibility has translated into growing automation of production lines. But such automation takes on a new dimension when robots can actually collaborate with humans in a shared workspace.

“ Renault didn’t expect a mobile robot to be able to ride within a van, while TAS operators were very impressed with the overall performance of the system. ”

Enter ColRobot (Collaborative Robotics for Assembly and Kitting in Smart Manufacturing), an H2020 project that has spent the past three years working on an integrated collaborative robotic system. Their technology consists of a mobile manipulator which acts as a ‘third hand’ for production line workers: It can autonomously move around the factory looking for pieces or tools, deliver them or hold them while the operator performs another task.

TWO VERSIONS FOR TWO END-USERS

The solution was completed in two versions: one for Renault, and one for Thales Alenia Space. Renault uses the robot to remove non-ergonomic sequences of assembly tasks, while TAS uses it to automate low-level tasks while letting humans focus on tasks requiring specific expertise or attention.

“As far as Thales Alenia Space is concerned, ColRobot essentially supports operators in the preparation of washer and screw kits for satellite assembly operations, in the delivery of assembly kits directly to the assembly area, and as a third hand assisting the operator in the installation of satellite equipment,” says Prof. Olivier GIBARU, coordinator of the project. “Renault, on the other hand, will benefit from ColRobot by using it to get inside a van and perform tasks such as tightening or quality checks, thereby reducing or even eliminating operator exposure to poor ergonomic conditions.”

OTHER MILESTONE ACHIEVEMENTS

The fact that ColRobot can get into and move inside a van to perform assembly operations alongside the operator is perhaps one of the project’s most important achievements. But there are others. One of them is a wearable biometric signal capture system developed by Technaid, which recognises movement, orientation and position of the arms, hands and fingers of the operator and sends them to the robot to improve communication capabilities.

Fellow consortium member, AKEO+, on the other hand, developed a versatile and flexible three-finger gripper with force sensing which allows the grasping and pick-up of objects of various sizes and shapes. Thanks to



an embedded smart sensor, the gripper can also precisely detect, locate and isolate parts. Last but not least, Fraunhofer IFF enriched the system with machine learning techniques to detect the presence of humans in the vicinity of the robot and inform them when they get too close.

“The feedback was very positive,” says Prof. GIBARU. “Renault didn’t expect a mobile robot to be able to ride within a van, while TAS operators were very impressed with the overall performance of the system.”

TRL7 AND BEYOND

ColRobot has now reached TRL7, and Prof. GIBARU says that another two or three years of development will be required for the consortium to propose a usable product. “The solution cost is still very high from a hardware and software perspective, and it is necessary to make adaptations and modifications to the demonstrator before we can consider any industrial deployment.” Meanwhile, both Thales Alenia Space and Renault are already contemplating integration of the ColRobot solutions into new industrial applications.

COLROBOT

- Coordinated by Arts et Métiers ParisTech in France.
- Funded under H2020-LEIT-ICT.
- cordis.europa.eu/project/id/688807
- Project website: colrobot.eu
- ▶ bit.ly/2DAr4Qe



Hidden secrets of the global seafood trade revealed

Growing human populations are placing enormous pressure on the ocean's remaining resources. Clear seafood traceability can help by improving understanding of the intricacies of the global seafood trade, resulting in more transparent, traceable and sustainable seafood markets.

About one-fifth of the world fishery catches are from illegal, unreported and unregulated (IUU) fishing that threatens marine ecosystems and the recovery of overexploited fish stocks. These activities also short-change the economy, jeopardise livelihoods and are frequently linked to criminal networks.

As seafood trade routes become longer and more complex, there is an ever-increasing need to trace seafood from source to consumption. This will help identify where IUU fishing occurs, and how and where illegal products enter the market.

With the aid of a Marie Skłodowska-Curie Individual Fellowships grant under the EU-funded Horizon 2020 SNAPTRACE (Fishing in the dark: unravelling the global trade and traceability of the 'snappers') project, researchers addressed the challenge of IUU fishing using snappers (*Lutjanidae* family) as a model. This fish is one of the world's most highly prized yet misunderstood groups of fishes.

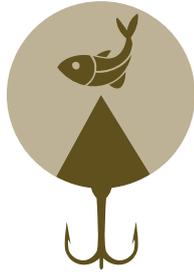
IMPACT OF MISLABELLING

Scientists applied a multidisciplinary approach to investigate what drives global snapper supply and demand. They employed state-of-the-art molecular techniques to harness the power of DNA barcoding and evaluate the species sold as snapper on world markets. "There are 112 species of Lutjanids and many countries allow any of them to be labelled as snapper," says lead researcher Dr Donna Cawthorn "and that's just the tip of the iceberg."

In fact, by DNA barcoding 300 samples collected from six countries, SNAPTRACE showed that lax application of the umbrella term 'snapper' and widespread mislabelling hid



About **1/5** of the world fishery catches



are from **illegal, unreported
and unregulated fishing**

the identities of at least 67 species from 16 families in marketplaces around the world. This effectively grouped together taxa for sale that derive from an array of disparately managed fisheries with markedly different conservation concerns. “Bringing this trade into the open will force international labelling and traceability policies, as well as enforcement measures, to be updated,” explains project coordinator Prof. Stefano Mariani.

The project also collated and compared production, import and export data from international and national statistical collections for the years between 2006 and 2013. Results indicated that official trade data severely lack the level of detail needed to track snapper trade flows, uncover potential IUU activities and inform the fisheries management of snappers and related species. “The lack of taxonomic detail and use of vague generic names in trade records are among the most insidious obstacles to seafood traceability. Therefore, widely used harmonised commodity classification systems should be developed to fill these gaps,” states Prof. Mariani.

“Bringing this trade into the open will force international labelling and traceability policies, as well as enforcement measures, to be updated.”

IMPORTANCE OF STANDARDISED TERMS

SNAPTRACE discovered that globally-used harmonised trade codes are not precise enough to record the true biodiversity exploited by fisheries. According to Dr Cawthorn: “This leads to vague denominations, which are further complicated by the global nature of the seafood supply chain. This makes trade permeable to illegal fishing products, hinders collection of reliable data and perpetuates the lack of transparency for consumers.”

Although researchers focused specifically on ‘snappers’, the same issues affect many other species that are also marketed under other umbrella terms, such as ‘groupers’, ‘croakers’, ‘sea bass’, ‘sea bream’ and so on. SNAPTRACE researchers are currently investigating some of these with new analyses. “If we consider the complexity of the myriad of international languages across the world, without robust standardised and harmonised trade denominations, the situation will always be intractable,” Dr Cawthorn concludes.

SNAPTRACE

- Coordinated by the University of Salford in the United Kingdom.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/701737
- Project website: marianilab.org/snaptrace

Dry-cured ham on the menu this morning, or will it be bacon?

EU research has investigated protein profiles for individual pigs so the producer will be able to determine the cut of meat from the genetics of the pig.

With genomic analysis, there has been considerable progress made in determining the variability of genomes in all main livestock species. However, linking the genome with its phenotype in terms of meat quality and type for the producer remains challenging.

Advances in 'omics' technologies are providing the necessary tools to extensively phenotype increasingly large collections of individuals. The EU Marie Skłodowska-Curie Individual Fellowship-aided project MARKTHEPIG (Applied phenomics to identify biomarkers in pigs for new concepts in precision livestock farming) has applied the newly emerging area of phenomics to merge the significant amount of data from omics technologies. Phenomics is an emerging trans-discipline that systematically studies the genome-wide phenotypic manifestations at cellular and organism levels.

MARKTHEPIG WORKS ON HIGHLY PHENOTYPED PIGS

As Prof. Luca Fontanesi, project coordinator of MARKTHEPIG, explains: "The aim of the current project was to take advantage of the knowledge obtained by the University of Bologna in highly phenotyped pigs to better understand the factors, both genetic and non-genetic, that contribute to the production variability of the animals." These factors have important consequences in designing selection and breeding strategies for this species.

MARKTHEPIG used mass spectrometry-based proteomics to identify new biomarkers that might describe internal or

molecular phenotypes to predict production performances of the animals at the genetic level. In addition, project results opened up new possibilities for use of phenomics to better characterise the pig as an animal model.

MOLECULAR BASIS OF DRY-CURED HAM

At the heart of the metabolism of an animal is its liver. For the first time, MARKTHEPIG described the molecular differences between two important pig breeds in terms of liver and its protein profile. "A total of about 500 proteomic spots were captured and identified. Of these, 25 resulted in differential expression in the livers of pigs belonging to two main heavy breeds of pig used to prepare dry-cured ham," outlines Prof. Fontanesi.

In terms of what makes ham or bacon, the team detected differences in the liver proteomic profile that might explain, indirectly, differences at the muscle tissue level. Results of

“ *This resource will become a sort of reference population for many other studies with a potentially high impact on the pig breeding and selection sector and on basic biology.* ”



the project's work have just been published in the peer-reviewed journal PLOS ONE.

CHALLENGES AND SOLUTIONS FOR ADVANCES IN PROTEOMICS

To fulfil the objectives of the project, MARKTHEPIG conducted advanced proteomics analyses that the local lab couldn't support. As a solution, alternative labs at the University of Bologna provided the necessary expertise in proteomics.

After the project closed, the host lab intended to continue to further exploit molecular phenotypes in the pigs. The goal is to further describe the genetic variability within and between breeds. "The biological repository we collected during these years will provide an important resource for future studies based on high-throughput molecular phenotyping technologies," notes Prof. Fontanesi.

Prof. Fontanesi acknowledges that the Marie Curie Individual Fellowship has enabled the formation of a larger reference population of pigs by adding other molecular phenotypes to a population of pigs already genotyped and phenotyped with many additional biomarkers. "This resource will become a sort of reference population for many other studies with a potentially high impact on the pig breeding and selection sector and on basic biology," he concludes.

MARKTHEPIG

- Coordinated by the University of Bologna in Italy.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/703094
- Project website: markthepig.eu

FOOD AND NATURAL RESOURCES

Organic food identified through new techniques

An EU-funded initiative has developed analytical techniques for determining the authenticity of organic produce following the dramatic growth of the organic food sector.

Over the last decade the consumption of organic food has increased dramatically around the world. In 2014, the EU-28 organic food market generated turnover of more than EUR 24 billion. Furthermore, the area of organically managed agricultural land now represents 5.7% of the total agricultural area in the EU-28.

The legislative framework has not kept pace with the organic market expansion, and further standardisation of analytical chemical techniques is necessary to support the accreditation bodies. Sampling procedures and other processes also need clarification, while scientific data is required for future activities. Currently, the lack of reliable markers for discriminating between organic and conventional products makes the market for organic food susceptible to attempted fraud.

As part of the Marie Skłodowska-Curie Individual Fellowships grant, the EU-funded H2020 ORGANIC QUAL TRACERS (Organic food quality control and metabolomic fingerprinting) project addressed these challenges using new

state-of-the-art techniques based on isotope-ratio mass spectrometry (IRMS) and high-resolution mass spectrometry (HRMS) in combination with multivariate statistical analysis (MSA) to improve both food quality and safety in organic products. "The project provided a wide range of information about contaminants, determining natural components and the chemical dissimilarities between products," says project coordinator Professor Amadeo Rodriguez.

FOOD COMPONENTS IDENTIFIED

The high selectivity and sensitivity of the HRMS technique enables the identification and characterisation of important natural food components present at trace levels. "It can identify the difference between conventional and organic production practices," explains Prof. Rodriguez. "The use of advanced software packages based on mass spectrometry (MS) and MSA is useful for cluster samples according to farming production systems."



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Electrospray ionisation HRMS was the best candidate for MS profiling studies, due to the latest advances in hardware and software performance. “The MS profile of a food sample can be used as an analytical signature of the food product and thus can help in discriminating between different practices, reflecting the impact of both internal and external factors as well as food properties,” comments Prof. Rodriguez.

The large number of signals detected in HRMS enables the statistical tools to extract sufficient data. In addition, MS profiling supported by MSA is a promising approach as plant profiles are a very rich source of natural markers. According to Prof. Rodriguez: “We can distinguish between different agricultural practices by using advanced mass spectrometry techniques based on HRMS in combination with powerful software tools like MS and statistical software packages like MSA to construct discrimination models and to establish (dis) similarities between products.”

AN IMPORTANT TOOL

ORGANIC QUAL TRACERS represents an important advance for productive and sustainable agriculture in the EU. “It provides a reliable quality food control tool for laboratories and organic certification bodies, while improving credibility among consumers towards organic products will help to

“ *The project provides a reliable quality food control tool for laboratories and organic certification bodies, while improving credibility among consumers towards organic products will help to support continuous growth in Europe’s organic food sector.* ”

support continuous growth in Europe’s organic food sector,” Prof. Rodriguez concludes. The results will support EU certification agencies and EU laboratories involved in determining the authenticity of organic products and detecting food fraud. This will increase consumer confidence about the authenticity of food labelled organic by the EU and limit possible fraudulent practices in organic farming.

ORGANIC QUAL TRACERS

- Coordinated by the University of Almeria in Spain.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/707816



New welding system builds storage tank market

In both industry and agriculture, the correct storage and processing of solids and liquids places extremely demanding requirements on tanks. This is especially true where problematic or aggressive substances are concerned.

The EU-funded Horizon 2020 TechTanks (Revolutionary rib-welding system for the worldwide first fully automated production of large, high quality, on-site welded tanks, bringing considerable cost savings to drinking water applications) project used a revolutionary rib welding system for the first fully automated production of large, high-quality, on-site storage tanks. This approach, developed by German SME LIPP GmbH, ensures the highest levels of quality for storing solid, liquid and gaseous substances.

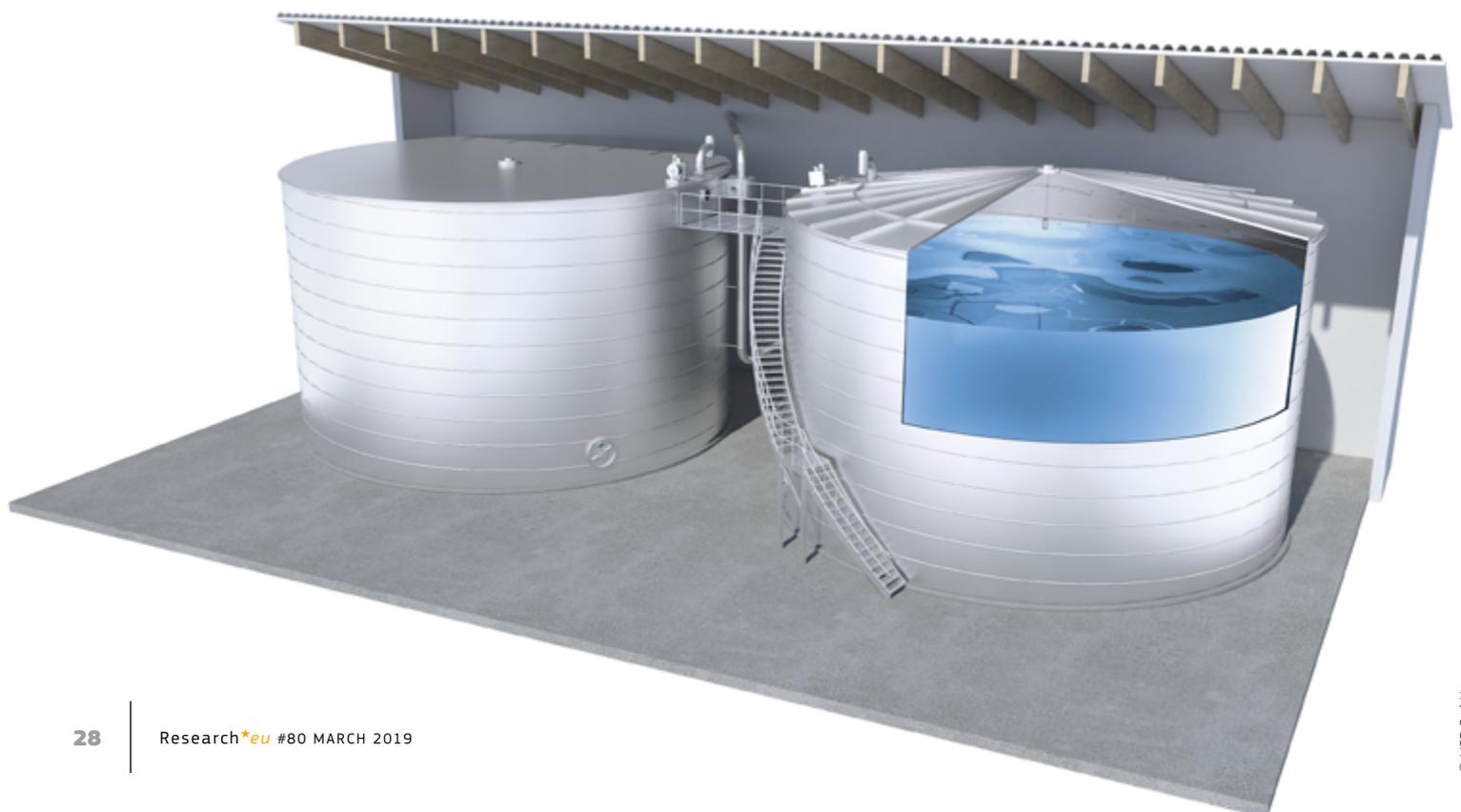
The company applied its experience of double seam technology to create a ground-breaking automated rib welding system for the on-site erection of novel, flexible, large-scale, high-quality welded stainless steel tanks at low cost. The LIPP rib welding system can also be applied to conventional welded steel tanks, thereby opening the market for large oil and pharmaceutical/chemical tank

applications, providing business opportunities in Europe and across the globe.

SIMPLE, FAST AND EFFICIENT

According to project coordinator Manuel Lipp, the LIPP system is based on a simple yet ingenious method of tank construction that is the only one of its kind in the world. "The process is fast and efficient and conducted on site to build tanks of various heights and diameters," he says. "They are built using an automated two-step procedure from steel strips. During the second step, the layers are joined together while the tank continues to grow upwards in a spiral."

Stability is ensured by tightly joining the steel strip using both the LIPP double seam system and the LIPP welding technique, while ensuring stability. Computer data and



“They are built using an automated two-step procedure from steel strips. During the second step, the layers are joined together while the tank continues to grow upwards in a spiral.”

video systems are used to remotely monitor the welding process. “Fitters watch the welding process from a safe distance in a control room. The necessary after-treatment of the weld is also automated, resulting in a weld that is extremely precise and smooth due to the automated continuous process,” explains Lipp.

The speed of the manufacturing process almost doubled following the use of wider steel coils and by increasing the welding speed. Furthermore, the processing of thicker steel sheets is also being addressed. As a result, far larger tanks with diameters of more than 20 metres may soon be possible.

COST-EFFECTIVE SOLUTION CREATES NEW MARKETS

Marketing the revolutionary rib welding system was also central to the entire TechTanks project. “We promoted our welded tanks at regional and international trade fairs and visited many companies around the world to highlight the new LIPP welding process,” states Lipp. “Customer feedback was consistently positive, and we have implemented several pilot projects,” he adds.

Significant material and manufacturing cost reductions of up to 45 % are possible due to the efficient, fast and automated on-site welding units. Cost reductions will lead to a unique selling position for applications in water and food industries, especially in drinking water storage.

The water and food industries mainly use such types of tanks because of the strict hygiene regulations in this sector. Conservative estimations of the drinking water market show a yearly revenue of EUR 13 million in a EUR 1 billion market segment after successful introduction of the technology in the next five years.

In addition, the LIPP rib welding system can be applied in the market of conventional welded steel tanks, creating a market for large oil and pharmaceutical/chemical tank applications. “This will strongly enhance our profitability and growth performance by transferring a substantially improved technology and existing knowledge into innovative, disruptive and competitive solutions, seizing European and global business opportunities,” Lipp concludes.

TECHTANKS

- Coordinated by LIPP GMBH in Germany.
- Funded under H2020-LEIT-ADVMANU, H2020-LEIT-ADVMAT, H2020-SME and H2020-LEIT-NANO.
- cordis.europa.eu/project/id/726675
- Project website: lipp-system.de

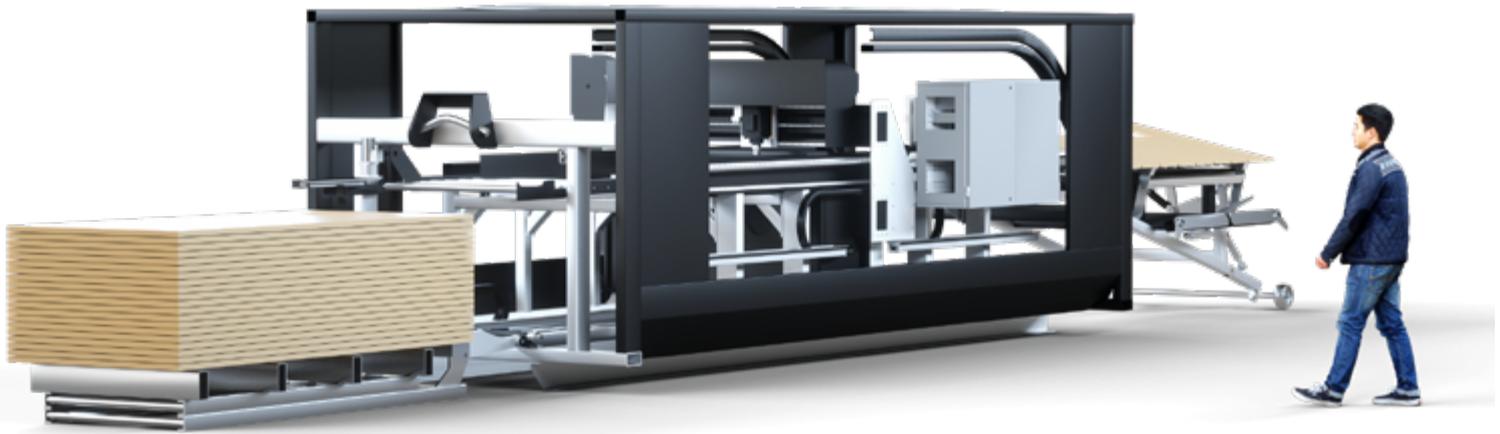
INDUSTRIAL TECHNOLOGIES

Cutting-edge technology for green, cost-effective do-it-yourself house building

Nowadays, there's a push in many European countries to create low-cost housing using factory-made modular units. Some experts believe this is a mistake and is repeating errors of the past.

“Architecture isn't just a roof over your head, it's central to a happy and productive society,” says Nicholas Showan, coordinator of the EU-funded HouseBuildR

(Build your house exactly as you imagined it) project. “Give people homes they'll love and they'll perform better in life and work.”



© Nicholas Showan

Showan emphasises that house building has changed little in the past 100 years. “There’s a need to build houses like we build cars, that is, from many precision components.” He also believes that focusing on building cheap accommodation for the poor is a false economy. “It will not engender a feeling of well-being in occupants, so the homes will be neglected and become rundown, as was the case with post-war tower blocks. People at all social levels are individuals and their homes should reflect this.”

RAPID DESIGN AND CONSTRUCTION OF GREEN HOMES

HouseBuildR devised a new method that’s able to create any architectural style to suit a wide range of personal and regional tastes. It will enable the construction of houses that are eco-friendly both to build and to run.

The project team built and configured a sophisticated large-scale computer numerical control (CNC) machine that manipulates machine shop tools using computer programming. It will allow developers or self-builders to design a house online by selecting an initial model and then adjusting it to accommodate their individual preferences. Rooms, walls, windows and doors can be added and adjusted as required to create a totally individual design without any limits.

Following the design phase, the data is downloaded to the mobile CNC machine that cuts the hundreds of plywood parts required to build the house. Users take the device to the building site to cut the 20 tonnes of plywood needed for a typical house. The parts are automatically cut by the CNC machine for rapid on-site assembly. This should minimise handling, damage, packaging and confusion.

END-TO-END HOUSE BUILDING AUTOMATION SOLUTION

While the twin-skinned box structure is being erected, ducting for electrical and other services is installed. The void is then filled with foam insulation creating a highly rigid and precise structure. This precision allows all downstream processes to be deskilled. After, the resulting monocoque core is clad in any desired material, including brick, slate, tile, wood and steel. In this way, any architectural style can be created, from reproduction period homes to highly innovative modern designs never before possible because of high costs. “The building costs are proportional to the materials used, not the design,” explains Showan. “Exciting architectural designs are possible at no extra cost.”

Now that HouseBuildR has finished, project partners have submitted a grant application to secure additional EU funding. “If successful, we hope to be building our first houses within the term of the project which is three years,” he says.

“Once fully developed, the HouseBuildR system will revolutionise the way we build houses today that are both eco-friendly and architecturally pleasing,” concludes Showan. “We will empower people who prefer to build their houses from scratch by letting them seamlessly manage a building project themselves and within budget.”

HOUSEBUILDR

- Coordinated by Jali Limited in the United Kingdom.
- Funded under H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/808670



New platform for those with little coding experience in developing mobile apps

Mobile phone apps have lacked an out-of-the-box CMS, such as WordPress for websites. King of App rectifies this with a platform which gives developers free code access to customise and adapt their apps.

By 2020 the mobile app market is projected to reach around USD 190 billion in revenues through in-app advertising whereby apps may be offered freely, and app stores where users typically pay for downloads. However, there remains a gap for users without coding experience wanting to develop apps themselves.

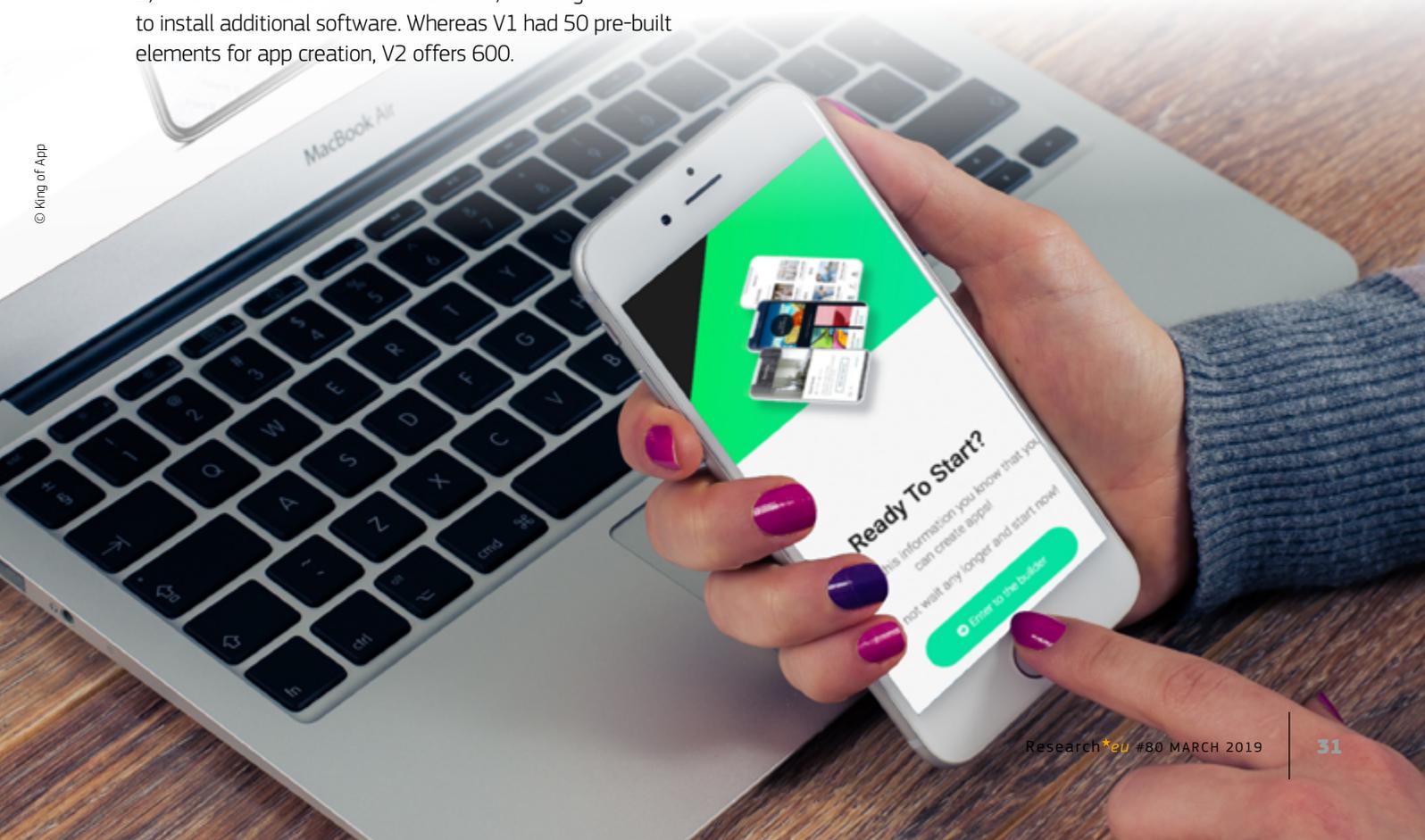
The King of App Version 1 was the first and only CMS for mobile app creation. The tool also allowed more experienced programmers and designers to create or customise additional templates and modules for clients or sell them through the King of App store.

EU support has enabled King of App to upgrade to Version 2, which now has an online code editor, avoiding the need to install additional software. Whereas V1 had 50 pre-built elements for app creation, V2 offers 600.

THEMES, MODULES AND SERVICES

The starting point for the King of App (Launching the First Open Source Mobile Content Management System for Apps) project was the realisation that it proved expensive to develop apps because there were not enough app developers, and a solution could lie with enabling web developers to do so.

As project coordinator Mr Xavier Barata says, "We started by creating a tool that utilised the same knowledge and technology that web designers use to create websites, but for fully customised apps. In short we converted web technology to app technology, to make the app equivalent to WordPress."



King of App offers a platform with a pre-built base for the integration of three types of elements, by following basic selection rules: themes, modules and services. Templates allow users to define the look and feel, while modules add functionalities. Services are executed in the background, collecting data, or triggered to appear for specific actions such as push notifications or analytics. The V2 package also includes an automatic publishing and signing system, using the developers' own id.

"Being open source, users have access to the code and, once downloaded and converted, these users become app owners – something of a paradigm shift for this type of technology," says Barata.

King of App follows a freemium business model meaning that app creation is free, as are the templates and modules, saving money and time, as with the automatic compilation and publication service, allowing app creation in minutes, as opposed to hours if done manually.

The combination of these elements, along with free access to the code, allows users to adapt or create apps cheaply – currently EUR 50 per app, per year – while letting web developers create fully customised iOS and Android apps for customers.

A NEW DIGITAL MARKETPLACE

While helping to popularise mobile access amongst citizens, King of App should also help kick-start a new digital

“*Being open source, users have access to the code and, once downloaded and converted, these users become app owners – something of a paradigm shift for this type of technology.*”

marketplace for the creative industries, such as software companies and advertising, previously precluded from taking part due to entry costs. This will create new jobs and strengthen the mobile industry.

To date, King of App has more than 12 000 apps created via its platform with customers in more than 55 countries. It continues to grow as it becomes an industry standard for app creation.

Looking to the future, Barata says, "We want to give platform access to new disruptive technologists, while developing new tools that engage brands and users, such as our new automated push or mobile analytics."

KING OF APP

- Coordinated by King of App SL in Spain.
- Funded under H2020-LEIT-ICT and H2020-SME.
- cordis.europa.eu/project/id/726743
- Project website: kingofapp.com/es
- ▶ bit.ly/2GrjQSi

DIGITAL ECONOMY

The science behind subtitling – how to enhance the user experience

Subtitles, we've all seen them and we are using them more than ever as material in a variety of languages becomes more accessible. At the same time, the population is aging and subtitles are a useful resource.

Subtitling is used not only by people who do not know the language of the original soundtrack, but also by those requiring different means of accessing audiovisual content due to sensory impairments, caused by deafness, hearing loss or ageing. With more and more content available on demand, the way in which we consume audiovisual

material is growing so understanding how we interact with subtitling is increasingly more important.

The EU-backed SURE (Exploring Subtitle Reading Process with Eyetracking Technology) project's principle investigator Dr Agnieszka Szarkowska explains how the work she

has been doing, with support from the Marie Curie programme, has helped us to gain a better understanding of how subtitles are processed.

Among the most problematic issues in subtitling quality are optimum presentation rates and subtitle layout. Subtitlers are faced with a lack of research data to support their current practices, which results in a lack of uniform standards on reading speed, inconsistent layout and poor-quality subtitling. “Through the research I was conducting under the SURE project, we wanted to analyse how subtitles are read to establish the most effective way to help audiences immerse themselves in what they are watching,” says Dr Szarkowska.

To get these insights, the researchers welcomed volunteers aged between 18 to 40 as their subjects. “Our participants were either hearing native speakers of English (30 people), Polish (21 people) and Spanish (26 people), or English speakers that were hard of hearing (10) or deaf (10). They were all living in the UK at the time the study was conducted.” The researcher’s selection aimed to consider the responses of cultures which had diverse exposure to subtitles. “For example, programmes in Spain are usually dubbed, so we assumed Spanish people would not be very familiar with subtitling,” explains Dr Szarkowska.

“We showed people clips and asked them questions on comprehension, cognitive load, enjoyment, scene recognition, subtitle recognition and reading experience. We also recorded their eye movements with an eye tracker.”

The team found that people were able to follow faster subtitles and preferred to have less condensed text in subtitles in clips in a language they could understand. In the case of clips they couldn’t understand, they preferred subtitles which are traditionally more condensed. “We also found that subtitles which are segmented following natural linguistic units are easier to process,” she explains.

Results of the SURE project have been communicated to the research community as well as subtitling professionals. “I would love people in other countries to replicate the study to see if the results hold true elsewhere. Ideally, companies would revise their style guides to implement our results,” says Dr Szarkowska.

SURE

- Coordinated by University College London in the United Kingdom.
- Funded under H2020-MSCA-IF.
- cordis.europa.eu/project/id/702606
- ▶ bit.ly/2FfyLh4



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LIFE AFTER...

Catching up with ABBI: Commercialisation beckons for the unique bracelet for visually-impaired children

*In issue 66 of Research*eu magazine, our special section highlighted several EU-funded projects that have worked hard to improve the lives of visually-impaired people through innovative technological solutions. The ABBI project was featured due to its pioneering device that would help visually-impaired children develop a better sense of space. Coordinator Dr Monica Gori tells us how much further along the road to commercialisation they've travelled since we last spoke.*

The Audio Bracelet for Blind Interactions (ABBI) is a pioneering device that is specifically designed with children in mind and thus its simplicity was a key factor – worn on the child's wrist and being not much bigger than a wristwatch, the device, once worn, starts sensing body motion, providing the user with spatial information on where the movement is taking place with a series of sounds. When worn by many people, – the child's immediate family for example – it provides a better sense of events and improves the social skills of the visually impaired.

THE ABBI-K LEADS THE WAY

Dr Gori had previously told us that the project team had hoped for full commercialisation within a year, and with the successful end of the ABBI clinical trial and the 'ABBI-K' kit (containing the ABBI wrist device and a set of speakers) soon to be distributed to hospitals and rehabilitation centres, it looks like they're not far off the mark. "ABBI-K will help therapists to provide rehabilitation using the ABBI

device in a simple and intuitive way," comments Dr Gori. "We're also finalising the procedure for the CE mark, so it seems we're in a very good place right now!"

Now she and her team are working on a comprehensive business plan for ABBI's full market penetration. "The main challenges we've faced in this respect are to secure the right investors for the product and to determine who of my team (or outside of my team) will lead the future ABBI startup as its CEO," Dr Gori explains. "We've also had valuable support from our specific Technology Transfer office here in Italy on finalising all of these, and several hospitals and rehabilitation centres in Italy have shown a big interest in our device and general approach."

MAKING ABBI GO FURTHER

Even with the great strides towards market entry, Dr Gori and her team are still determined to maximise ABBI's great potential. "Up until now, we've only worked with ABBI on children above the

age of three but I'm convinced that the use of ABBI could be crucial to improving spatial, manipulation and social skills for visually-impaired children in the crucial first three years of their lives," says Dr Gori. "I plan to fully explore this notion further, especially due to the fact that, to date, there are only a few technological rehabilitative solutions developed for early intervention in young visually-impaired children."

So it seems the only way is up for ABBI. As Dr Gori concludes: "I think that the ABBI project opened a cascade of big opportunities for the rehabilitation of visually-impaired children."



ABBI

- Coordinated by the Italian Institute of Technology in Italy.
- Funded under FP7-ICT.
- cordis.europa.eu/project/id/611452
- Project website: abbiproject.eu



Dr Monica Gori
Project coordinator of ABBI
© Monica Gori

"I think that the ABBI project opened a cascade of big opportunities for the rehabilitation of visually-impaired children."



New device enables satellites to decommission themselves

Italian company D-Orbit has developed flight-ready technology that can be integrated into satellites and remove them from orbit quickly and safely at the end of their mission or when they become unresponsive.

In over 50 years of Space activity, about 7 000 satellites have been launched, with only 2 000 of them still being active today. "Satellites are not being removed once they've served their purpose. Conjure up the image of a car that has run out of fuel on a highway as an analogy. It is fine to leave it in the place where the engine has stalled, but when traffic starts to grow, there will soon be a congestion problem. This is what the situation looks like in Space," points out Stefano Antonetti, Head of Sales for Institutional Business of D-Orbit.

PLENTY OF SPACE FOR MANOEUVRE

With EU funding of the D3 (Smart propulsive device for controlled satellite decommissioning and reentry) project, Italian company D-Orbit has successfully set the stage for effectively and affordably cleaning up old satellites from Space. They developed a decommissioning system that removes satellites at the end of their mission or if a major failure occurs.

“ Thanks to our patented onboard propulsive system, this is the first time in Space history that such a skilful decommissioning manoeuvre of a satellite has been attempted. ”

D3 actually refers to the dedicated propulsive device installed on the satellite prior to launch that either drives it out of its orbit where it does not interfere with any other satellites or returns it to Earth. “One of the main advantages our technology boasts is that it enables us to plan a controlled route/course/path. Indeed, our system is equipped with such a sophisticated motor that we can redirect the satellite to a specific area of the globe – usually to the middle of the ocean where it is quite certain that it will not pose any threat,” adds Antonetti.

Part of the project was to demonstrate the operation of the D3 system in a small test satellite, a bit larger than a shoe-box, called D-Sat. “Thanks to our patented onboard propulsive system, this is the first time in Space history that such a skilful decommissioning manoeuvre of a satellite has been attempted,” notes Antonetti. After more than three months of orbital operations, D-Sat completed its mission by test-firing its onboard propulsive unit, successfully validating the decommissioning technology in Space.

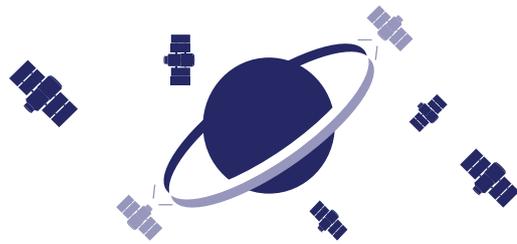
POWERFUL MOTOR

Current international guidelines recommend that satellite operators de-orbit their satellites within 25 years from the end of operation, but only a small number of missions actually do that. “Satellites use propulsion for station keeping – that is to compensate for orbital perturbations. But, current built-in motors are so tiny that they provide 20 Newton of thrust which is just like pushing two kilogrammes. Our onboard motor system provides a much larger force, about 800 Newton, which translates to pushing 80 kilogrammes. This is the reason why almost all decommissioning manoeuvres fail. We have just not been using the right tools until now,” explains Antonetti. The decommissioning system built into D-Sat can be scaled up to any size satellite.

FUTURE ASPIRATIONS

The ambitious aim of D-Orbit is to use its patented D3 technology and reduce the growing amount of debris surrounding the Earth. In addition to significantly mitigating Space debris, the aerospace professionals also aim to expand to the market of on-orbit satellite servicing. “It would be very nice if we could target certain satellites

In over **50 years** of Space activity,
about **7 000 satellites**
have been launched,
with only **2 000** of them still being
active today



and try to repair them – just like when car service companies come to your place to fix your car. This might not be very easy in Space now, but we will get there pretty soon,” concludes Antonetti.

D3

- Coordinated by D-Orbit SRL in Italy.
- Funded under H2020-LEIT-SPACE and H2020-SME.
- cordis.europa.eu/project/id/711193
- Project website: deorbitaldevices.com
- ▶ bit.ly/2CWQoRj

On the chemical trail from star-forming clouds to planet-forming disks

Astronomy relies on new facilities, enabling observers to see deeper, sharper and more sensitively than previously possible. The CHEMPLAN project combined models, lab experiments and data from the new ALMA array to zoom in on protostars and disks, at planet forming scales.

New planetary systems form in the rotating disks of gas and dust around young stars. These disks are small, containing less than 1% of the mass of the parent cloud that collapsed to form the system making them hard to observe, requiring instrumentation with high spatial resolution.

The ERC-supported CHEMPLAN (Astrochemistry and the Origin of Planetary Systems) project took advantage of data coming from the new Atacama Large Millimeter/submillimeter Array (ALMA) to probe the chemical composition over the full range of temperatures in these regions, from 10-1 000 K.

The project succeeded in characterising the physical and chemical structure of star-forming clouds and planet-forming disks with unprecedented sharpness – on scales comparable to our own solar system. It also linked their chemical composition with that of cometary and exoplanetary systems, suggesting a pre-solar cloud origin for the

molecules, which were not significantly changed en route to disk and comet.

INTEGRATED TRIANGLE OF OBSERVATIONS, MODELLING AND LAB EXPERIMENTS

CHEMPLAN's commencement coincided with that of ALMA, an array of 54 telescopes on a high altitude plain in Chile. ALMA has proven particularly well suited to finding molecules in nearby star-forming regions. It also surveyed large numbers of disks quickly to determine their structure and potential to form new planets.

"ALMA does in one minute what it took a full night with a pre-ALMA array. Whenever a new ALMA data-set is delivered, it is like unpacking a Christmas present." CHEMPLAN project coordinator Professor Ewine van Dishoeck says.

To analyse the ALMA data, CHEMPLAN needed models of chemical kinetics and laboratory experiments to study basic chemical reactions in ices under space-like conditions.

Regarding the modelling, the survival of molecules from clouds to disks, with the subsequent chemical changes in the disk, was quantified. For example, the team showed how C/O and C/N ratios (ratio of overall carbon to oxygen and carbon to nitrogen) depend on physical parameters such as temperature and ionisation rate. Moreover, the disk chemistry was subsequently coupled with planet-formation models that showed the importance of gas versus ice accretion to set the C/O ratios in exoplanetary atmospheres.



The laboratory experiments have proven important in explaining the ALMA detection of complex organic molecules, like sugars and amides in a young disk around a solar-type protostar, and also their formation pathways in ices. Another major result was the first detection of a dust trap in a circumstellar disk, the site of future planetesimal formation.

“These findings suggest that planet formation starts at an earlier stage than previously thought, and that water and pre-biotic molecules are already present in abundance. Both findings contribute to our attempt to answer the most fundamental questions: ‘where do we come from?’ and ‘could there be life elsewhere in the Universe?’” Professor van Dishoeck says.

To take the work forward, the team will undertake more and deeper ALMA spectral surveys of young disks to

investigate the prevalence of the current findings for just a few systems. Additionally, they will link observations from the James Webb Space Telescope of the inner regions of protoplanetary disks, with the outer disk and with exoplanetary atmosphere compositions. The researchers will also continue to fine-tune the underpinning molecular data needed to understand the chemical trail from clouds to disks.

CHEMPLAN

- Hosted by Leiden University in the Netherlands.
- Funded under FP7-IDEAS-ERC.
- cordis.europa.eu/project/id/291141

SPACE

European youth encouraged to reach for the stars

The study of space has a strong connection with science, technology and culture, making it a unique and well-rounded educational tool. An EU network leveraged inspirational aspects of European space and astronomy programmes to attract young people to space-related careers.

The EU-funded EUSPACE-AWE (EU SPACE AWARENESS) project engaged with children and teenagers both directly and indirectly to make space studies and science and technology more appealing. Efforts and actions centred on wide-ranging activities and high-quality educational resources for diverse groups that play an influential role in career decisions.

Project work targeted “a better understanding of the career aspirations of space-related workers, the vision that children have of space and space science, and the identification of best practices towards stimulating the next generations of space scientists,” says Professor George Miley, who co-coordinated the project with Prof. Pedro Russo, both from the Leiden Observatory, Leiden University, the Netherlands.

REACHING FAR AND WIDE

Through its dissemination and partner network, spanning 23 countries, EUSPACE-AWE succeeded in directly reaching over 70 000 people, including more than 4 000 students and 5 000 education professionals.

A total of 34 face-to-face teacher training courses were held in 15 countries, helping to enhance the work of close to 500 teachers and education experts. Furthermore, 2 401 teachers from 68 countries participated in and completed the professional training of at least one massive open online course.

Project partners hosted a 5-day International Space Education conference in 2016. Organised in collaboration

“*Education and outreach programmes that exploit space science are excellent value for money.*”

with the European Space Agency and the Galileo Teacher Training Programme, the event brought in 100 professional educators, engaging them through presentations and workshops. They also hosted two 6-day summer schools in July 2016 and 2017 in Marathon, Greece. Involving some 50 teachers, these courses also helped EUSPACE-AWE to assess the impact of its developed materials.

In line with the project’s high-priority approach to professional evaluation and sustainability, other outreach activities included high-impact events for teachers and policymakers at the European Parliament.

KNOWLEDGE FRONTIERS EXTENDED

The project team has provided a repository of innovative peer-reviewed educational resources, all accessible through the EUSPACE-AWE website. A dedicated career hub offers information on opportunities in space exploration and the career potential it represents, and two toolkits highlight aspects of the Galileo and Copernicus satellites. The ‘Journey of Ideas’ resource helps build a bridge between Islamic culture and Latin Europe by highlighting important contributions to scientific progress from Islamic scientists.

Another resource developed by the project is Space Scoop, a space news service for children from the age of 8 and up. This is an engaging tool that can be used in the classroom environment. It has also been showcased on the Universe Awareness website of the FP7 project EU-UNAWA.

A series of videos is also available online, including one titled ‘Inspiring Every Child with our Wonderful Cosmos’.

EUSPACE-AWE held a total of 160 events through its network, which comprises 14 formal nodes, four partner nodes and six informal organisations. Over 100 of these were public events and more than 40 focused on education professionals’ development in the use of space in the classroom. The Science Diplomacy and International Development symposium marked the closing of the project.

NEW LAUNCHES IN THE WORKS

As Prof. Miley states, “space research and knowledge about our universe are inspirational and exciting. Many scientists and engineers became interested in their disciplines through their early exposure to the fascinating world of space.” It’s not surprising then, that EUSPACE-AWE partners believe “education and outreach programmes that exploit space science are excellent value for money.”

Project outcomes clearly mirror this through the extensive efforts of its international network and the myriad, all-encompassing resources it has provided for young Europeans and all those involved in their educational journey.

The journey doesn’t end here. “We regard it as essential that our networks and extensive educational repositories be sustained,” the professor concludes. “We have begun taking initiatives to ensure this, including submitting a new proposal, SpaceEDU, to the Horizon 2000 Space Call.”

EUSPACE-AWE

- Coordinated by Leiden University in the Netherlands.
- Funded under H2020-LEIT-SPACE.
- cordis.europa.eu/project/id/638653
- Project website: space-awareness.org
- bit.ly/2RiWLHB

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New methods unveil the true quantum nature of molecular collisions

Observing and controlling molecular collisions has long been considered as the Holy Grail of chemical physicists. New methods developed under the MOLBIL project make it possible for both 'electric' and 'magnetic' molecules.

Whilst molecules colliding may undergo a chemical reaction, more often they only transfer energy to each other: they end up rotating a little faster or moving a little slower. This seemingly simple event plays a key role in an amazingly wide variety of processes: the formation of stars and planets, combustion, the heating balance of the atmosphere, and even processes in certain quantum computers.

We already have a good understanding of such collisions at high energy levels. Low energy collisions, however, are a completely different matter: only quantum mechanics can describe the scattering process. Appropriate methods were missing until the MOLBIL (Molecular Billiards in Slow Motion) project came up with a way to image the true quantum nature of molecular collisions.

Together with his team, Prof. Dr Sebastiaan van de Meerakker has developed methods to completely control the motion of molecules before collision, so as to ensure that they collide under extremely well-defined conditions. Such control allows for taking a zoomed-in picture of the process, revealing collision mechanisms that would otherwise remain hidden.

"The first task is to carefully control the velocity of the molecules, so as to get a result that we can interpret more easily," says Prof. Dr van de Meerakker, coordinator of MOLBIL. "This is somewhat like a car manufacturer conducting a crash test: you don't learn much from looking at the car wreck if you don't know how fast the car was driving at the time of impact".

The 'Stark decelerator', which controls velocity, is what makes MOLBIL results unique as Prof. Dr van de Meerakker explains: "Not only can we control the absolute velocity of the molecules, but we also control the velocity

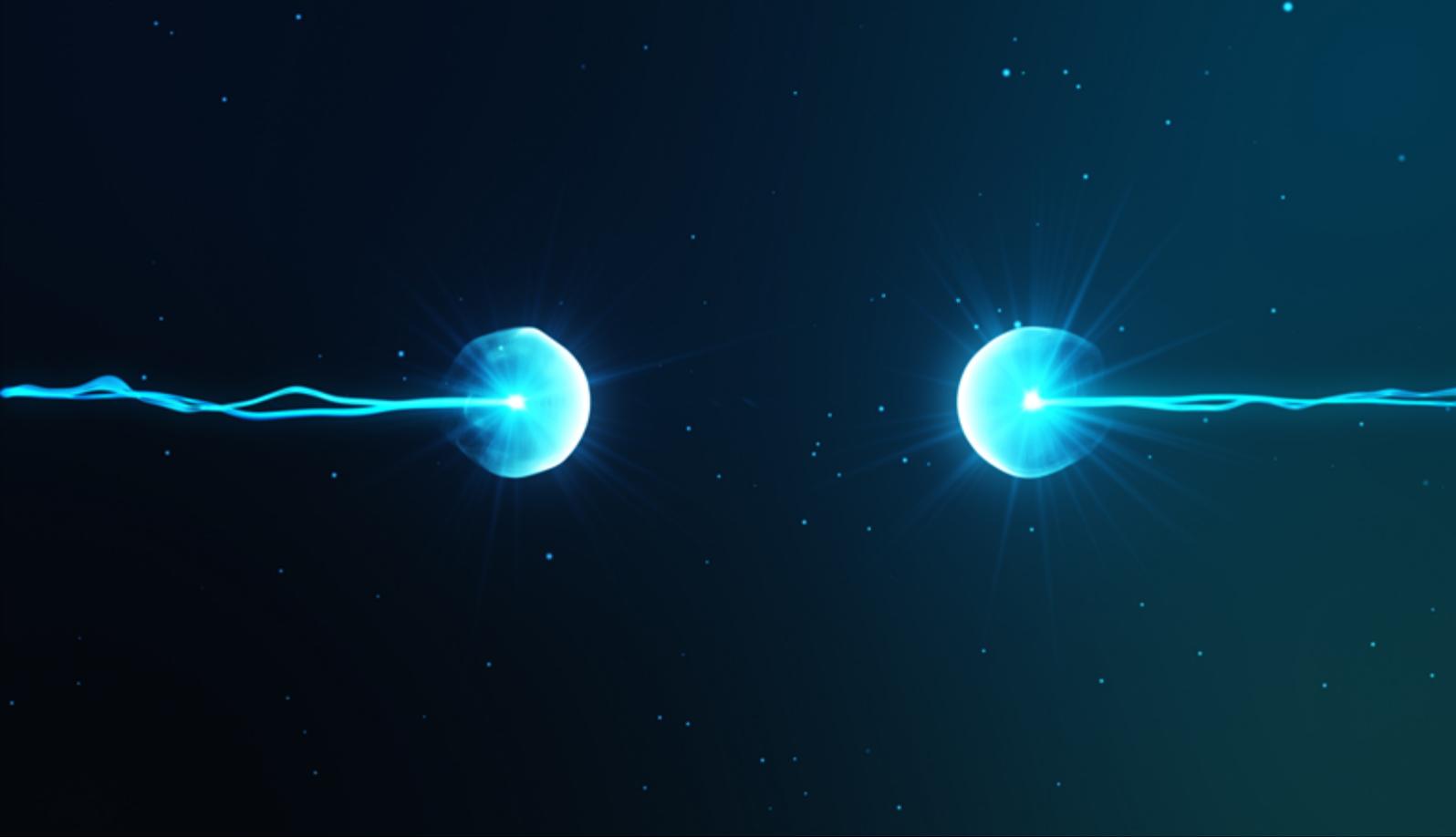
spread of an ensemble of molecules that all take part in the collision process. The former is important for controlling or scanning collision energy, while the latter is important for scanning the collision energy in high resolution (collision energy uncertainty)."

“Not only can we control the absolute velocity of the molecules, but we also control the velocity spread of an ensemble of molecules that all take part in the collision process.”

This method allowed the team to observe scattering phenomena that had been predicted theoretically decades ago but had yet to be observed experimentally. These include quantum diffraction oscillations, low-energy scattering resonances and product-pair correlations.

As the Stark decelerator only works for 'electric' molecules (those having an electric dipole moment), and not for magnetic ones, the team also used the Zeeman decelerator. "Using a series of electromagnets, we can get full control over magnetic molecules, allowing us to study a whole new group of atoms and molecules. Zeeman decelerators are not new, but we have developed a new concept that is particularly optimised for molecular collision experiments," says Prof. Dr van de Meerakker.

All in all, MOLBIL findings provide data that will challenge the preconceptions of theorists trying to solve the equations of quantum mechanics. Whilst this won't lead



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to market products anytime soon, Prof. Dr van de Meerakker is confident that project learnings will benefit many different scientific fields, such as research on quantum gases, astrophysics and meteorology.

And although the project is now completed, Prof. Dr van de Meerakker intends to pursue his research. "The collision energies that we have achieved so far correspond to collisions between molecules found in gas at a temperature of about 10 kelvin (and more). That is already a very low energy, but now we have a plan to modify the machine

to reach even lower temperatures. Whilst this may sound like a small change, it has in fact big implications," Prof. Dr van de Meerakker concludes.

MOLBIL

- Hosted by the Catholic University Foundation in the Netherlands.
- Funded under FP7-IDEAS-ERC.
- cordis.europa.eu/project/id/335646

FUNDAMENTAL RESEARCH

How to mass-produce flies the right way

As flies increasingly create a buzz, a consortium of EU researchers studied their biology and ecological features to improve artificial and mass rearing practices.

To most people, flies are just an annoyance. Sure, they're nature's best recyclers and play an essential role in our ecosystem. But that doesn't make them any more tolerable to the layperson.

There is, however, a market that is beginning to consider flies as tomorrow's gold. Since EU Regulation 2017/893 came into force on 1 July 2017, insect proteins from seven different species – including house flies and black soldier flies (BSFs)



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– have made their way to the aquaculture business. These flies are now authorised for use as feed for fish and crustaceans, with substantial benefits for the environment.

The BSF, for instance, is largely recognised as one of the insects with the most potential for the sector. And this is just a start: European Commission services are currently exploring the possibility of authorising insect-based proteins in feed for poultry and other animals. According to the likes of the FAO and IPIFF (International Platform of Insects for Food and Feed), insects as a source of proteins will largely contribute to future food security.

This whole trend calls for sounder mass rearing, which was precisely the focus of FlyHigh (Insect-plant relationships: insights into biodiversity and new applications). The project studied underexplored fly species along with more common ones, with a view to elucidating specific ecological features that would make them ideal for controlled artificial rearing and mass production. In one of their studies, they focused on the genetic diversity of different strains of BSFs around the world.

“After a survey of samples from different commercial and research cultures, we found a surprisingly high molecular divergence for the COI mitochondrial barcode marker. Molecular characterisation of cultured BSFs revealed distinct haplotypes when compared to flies obtained from natural habitats, and we found that the barcodes reveal the geographical origin of the tested flies,” Dr Gunilla Ståhls, researcher at the University of Helsinki, explains. This discovery enabled the creation of a comprehensive library of BSF barcode sequences linked to geographic data, which will be informative for current and future programmes of artificial rearing, selection and intensive production.

FlyHigh also explored ways to improve controlled rearing protocols, including optimal temperature, humidity, diet and density for the BSF and other fly species. The team

analysed and compared different larval feeding media and evaluated the performance of different strains of flies on these substrates. “The enhanced artificial rearing protocols increased maggot activity and enabled more effective and sustainable fly production,” Dr Santos Rojo, project partner at the University of Alicante, notes.

Another key part of the project consisted in describing and characterising flies’ ecological requirements and interaction with plants. “We found that groups of flower fly species that feed very little during the adult stage can be better characterised biologically if the larval stage is also studied. We collected taxonomic and ecological data for fly species distributed in Mediterranean ecosystems in both Europe and South Africa, recorded new host plants such as specific bulb plants (e.g. lilies) and aloe succulent plants for these species, and found that insect-plant relationships varied considerably among the studied species – showing potential patterns of coevolution between them,” says Dr Aino Juslén, coordinator of FlyHigh on behalf of the University of Helsinki. The researchers also systematically screened selected molecular markers to evaluate the genetic diversity and phylogeographical patterns of the flies and their host plants, and have documented the results in multiple scientific publications.

All in all, project results will help make fly rearing more efficient. It could also be advantageous in developing new ideas for future use by recognising their important role in natural ecosystems.

FLYHIGH

- Coordinated by the University of Helsinki in Finland.
- Funded under H2020-MSCA-RISE.
- cordis.europa.eu/project/id/645636
- Project website: luomus.fi/en/flyhigh



AGENDA

APRIL 2019

BUDAPEST, HUNGARY

Urban Nodes Forum

→ vitalnodes.eu/events/urban-nodes-forum

3→4
APRIL

7
APRIL

WORLDWIDE

World Health Day

PARIS, FRANCE

Modern2020 International Conference

→ modern2020.eu/news/modern2020-international-conference.html

9→11
APRIL

10→12
APRIL

PRAGUE, CZECH REPUBLIC

EOSC-hub Week 2019

→ eosc-hub.eu/events/eosc-hub-week-2019

12
APRIL

WORLDWIDE

International Day of Human Space Flight

23→24
APRIL

RIGA, LATVIA

Energy Efficient Mortgages Event

→ eemap.energyefficientmortgages.eu/upcoming-events

MORE
EVENTS
cordis.europa.eu/news

2-3 APRIL

BRUSSELS, BELGIUM

2nd European Conference on Connected & Automated Driving

Organised by the European Commission and the EU-funded ARCADE project, this is the only conference in Europe that brings together political leaders from the Commission and EU Member States and high-level industry representatives and road authorities to discuss all the challenges related to automated mobility. Also, keep an eye out for an upcoming CORDIS Results Pack on this very topic!

→ connectedautomateddriving.eu/eucad2019

NEW RESULTS PACK ON NANO-ENHANCED ADVANCED MATERIALS

Our newest Results Pack highlights 14 innovative projects that have played a leading role in propelling advanced nanomaterials research from the lab and out onto the market! With applications in healthcare, manufacturing, transport and energy (to name but a few), the large-scale uptake of nanomaterials offers many exciting opportunities for European industry.

Check out the Pack here:
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