

AI-enabled Industrial technologies and manufacture

EXPLORERS Exploring epigenetic robotics: raising intelligence in machines

Results in Brief

Baby steps for robots

An EU team opened new perspectives for lifelong robot learning by duplicating child-like learning strategies. The study facilitated robot learning through exploration and curiosity, and autonomous goal-setting, leading to efficient skill-acquisition.



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Even after 50 years of development, robots still do not approach the capabilities of a human infant to adapt to its continuously changing environment. Instead of attempting to directly simulate adult-like robot intelligence, a new approach focuses on recreating a child's learning and development experiences for machines.

The EU-funded EXPLORERS (EXPLORERS Exploring epigenetic robotics: raising intelligence in machines) project investigated the building of robots capable of lifelong learning. Work focused on robot learning of sensorimotor and social skills in ways analogous to human infant development. The team transferred certain key mechanisms in human development to a robotic context, and in reverse shed light on aspects of human development such as the roles of curiosity and social learning in learning skills and language.

Researchers devised mechanisms of curiosity-driven exploration, drawn from human intrinsic motivation. The development allowed robots to discover how to use their

bodies and to explore physical objects in the environment. Robots acquired multiple skills autonomously including all-directional locomotion using legs, arm movements, control of flexible objects such as a fishing rod, and speech capabilities.

Next, the group developed human-like maturation techniques applied to motor and sensory channels. The results facilitated robot exploration of large spaces, and considerably accelerated learning.

The team studied for the first time how curiosity-driven sensorimotor learning could be combined with learning by imitation. Outcomes allowed robots to set their own goals, which the machines then autonomously attempted to solve. The robots also accepted human suggestions about choosing goals and strategies for their accomplishment.

EXPLORERS opened new possibilities for lifelong learning robots and artificial intelligence: beyond solving single tasks provided by engineers, the new techniques based on intrinsically motivated learning and social interaction allow robots to grow and develop like human babies. Applications could be found for robots that have to interact continually with humans in daily environments, or in educational technologies to foster curiosity and learning in humans.

Also, the project led to the creation of the first world-wide open-source 3D printed robotics platform [Poppy system](#). It was initially used to test learning algorithms but is now used by teachers in high-schools and by artists.

Keywords

Robots, artificial intelligence, lifelong learning, curiosity, EXPLORERS, learning, epigenetics, development

Project Information

EXPLORERS

Grant agreement ID: 240007

Closed project

Start date

1 December 2009

End date

31 May 2015

Funded under

Specific programme: "Ideas" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Total cost

€ 1 572 215,00

EU contribution

€ 1 572 215,00

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Biopolymer architecture company tools up for production



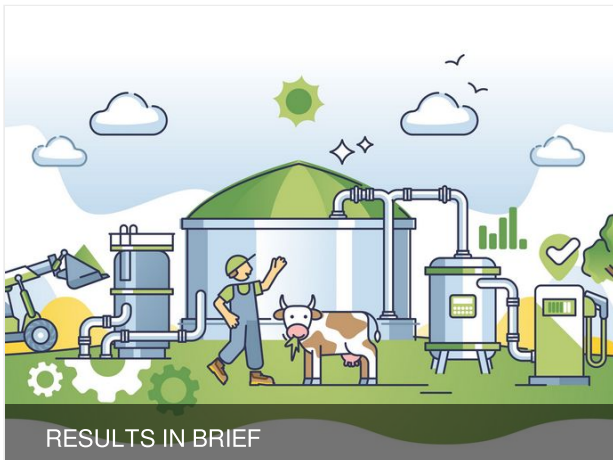
5 February 2024



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5 February 2024



A one-step, green and economical way into converting methane to liquid fuels



28 April 2023

Last update: 30 August 2016

Permalink: <https://cordis.europa.eu/article/id/188403-baby-steps-for-robots>

European Union, 2024

Safe and effective HumAn-Robot coopEration toWards a better cOmpetitiveness on cuRrent automation lack manufacturing processes.

Results in Brief

Smart solution to support human-robot collaboration

A modular software/hardware toolbox for industrial collaborative robots enables human-like perception, human-aware dynamic planning and safe manoeuvring without safety fences.



DIGITAL ECONOMY



INDUSTRIAL
TECHNOLOGIES



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Industry 5.0 goes beyond Industry 4.0's automation of individual robots and a focus on productivity and efficiency to an approach based on human-robot collaboration. This human-centric paradigm still contributes to industry's bottom line but also reinforces industry's ability to contribute to society.

Collaborative robots, also called cobots, are designed to work safely with human operators without conventional safety fences. They will form the foundation of Industry 5.0. The EU-funded [SHAREWORK](#)  project, part of the

[Effective Industrial Human-Robot Collaboration](#) cluster of projects, developed a solution to support them. It comprises 14 hardware and software modules that have been validated in four industrial manufacturing use cases.

Collaborative robots: perception, mobility, safety and communication

“SHAREWORK merged robotics, AI and the social sciences to bridge the gap between manual and fully automated tasks, combining the accuracy, repeatability and efficiency capabilities of robots with the intelligence and flexibility of humans,” explains Néstor García of the [Eurecat Technology Centre of Catalonia](#) , technical project coordinator.

The consortium’s modular solutions integrate perception, motion planning, safety and communication. They enable collaborative robots to ‘cognitively’ assess their environment and respond to it. The robots can detect and respond to the operator’s presence and movement in real time; perform human-aware dynamic planning and scheduling; and navigate their environments safely. They even adjust themselves to ensure proper workers’ posture. An operator training module harnessing augmented reality develops operators’ technical capabilities and fosters acceptance.

Human-robot collaboration in action: four industrial manufacturing use cases

Robots with integrated SHAREWORK modules shone in preassembly and assembly processes. One of the solutions assisted during the repetitive riveting tasks for the preassembly of tram metal door and window frames. The human-robot collaboration decreased assembly time while enhancing human welfare. Another supported the multistep assembly of large, heavy, metal positioning equipment, normally done manually. It was able to understand and respond intelligently to the operator’s intentions through advanced gesture recognition.

Car manufacturing received help from SHAREWORK’s modules integrated into a high-payload robot that carried, positioned and held heavy car doors and hoods while an operator executed their assembly/disassembly for painting. Finally, SHAREWORK’s collaborative robots worked with humans to move highly varied metal parts between storage and machining, understanding the worker’s behaviour and anticipating tasks to move seamlessly about the factory floor.

A more sustainable, human-centric and resilient manufacturing industry

The key to widespread adoption of human-robot collaboration is worker acceptance. SHAREWORK followed a cocreation approach including end users in early development stages. Beyond their benefits for products and companies, collaborative robotics can relieve workers of dangerous, repetitive tasks and their psychological

effects and associated injuries, while opening the door to added-value jobs. Further, having robots literally share the load enhances job inclusivity by removing physical barriers.

“The use of collaborative robotics and advanced digital technologies in industrial environments strengthens European industry, paving the way to sustainable, human centric and resilient manufacturing production lines. Involving human resources in co-creation allows for smoother technology adoption and greater inclusivity and gender equality,” concludes project coordinator Simona Neri of the Eurecat Technology Centre of Catalonia.

Anyone interested in learning more about human-robot collaboration and SHAREWORK outcomes can take part in one of five [open training courses](#), created by the SHAREWORK consortium.

Keywords

SHAREWORK, robot, human-robot collaboration, assembly, collaborative robots, manufacturing, Industry 5.0, robotics, augmented reality, cobot, mechatronics

Project Information

SHAREWORK

Grant agreement ID: 820807



DOI
[10.3030/820807](https://doi.org/10.3030/820807)

Closed project

EC signature date

12 December 2018

Start date

1 November 2018

End date

31 October 2022

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Advanced manufacturing and processing Technologies for Factories of the Future

Total cost

€ 7 351 467,51

EU contribution

€ 7 351 467,50

Coordinated by

FUNDACIO EURECAT

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Human-centric manufacturing: How new approaches to technology design can transform European industry

31 August 2023



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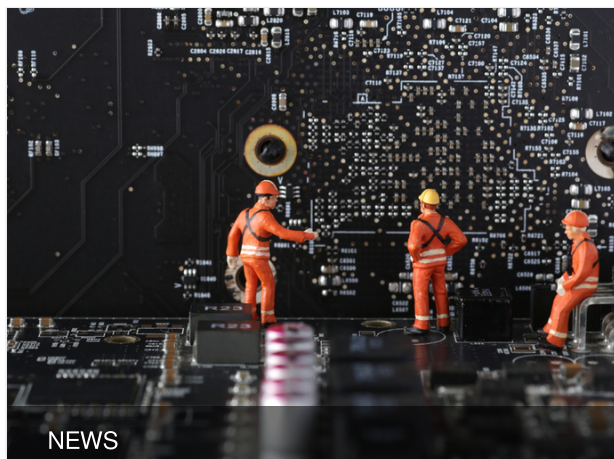


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28 April 2023

Last update: 10 March 2023

Permalink: <https://cordis.europa.eu/article/id/443003-smart-solution-to-support-human-robot-collaboration>

European Union, 2024

Advancing Econometric Methods for Analyzing Data from Regression Discontinuity Designs

Results in Brief

Machine learning improves the estimation of the causal effects in regression discontinuity designs (RDD)

An EU-funded project has extended the range of methodological tools for researchers working with regression discontinuity designs through use of modern machine learning techniques.



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A valuable methodological tool to study cause and effect relationships, the regression discontinuity design (RDD) plays a significant role in a growing number of research programmes. To further refine RDD and make its analysis more accurate, the RD-ADVANCE project examined and developed new methods to be applied in studies using this evaluation design.

“RDDs allows researchers to learn about causal relationships in certain settings where randomised controlled trials are not feasible and observational data has to be used instead,” explains [Christoph Rothe](#) , professor of economics and RD-ADVANCE project coordinator.

“The newly developed methods will allow researchers in areas, such as economics, education and public health, to better quantify the causal impact of different types of policy measures,” adds Rothe.

Developing new methods for RDD

RD-ADVANCE, coordinated by the University of Mannheim in Germany, was divided into three parts to evaluate different elements of RDD. In the first part, team members developed methods to incorporate covariates (independent variables that can influence the outcome of a given statistical trial) into the analysis of regression discontinuity designs. This was carried out with the help of AI to allow for more precise conclusions.

“Specifically, machine learning was used to extract information from a potentially large number of covariates, which in turn is then used to reduce the variance of regression discontinuity estimates of causal effects,” notes Rothe. With the expanded techniques, Rothe says researchers will be able to reduce the uncertainty resulting from limited data and, therefore, give better policy advice.

In the second part of the project, the team studied the confidence intervals (CIs) commonly used in statistical analysis. These CIs are based on standard errors clustered by a certain variable, called the running variable. The aim of these common CIs is to quantify the uncertainty related to the treatment effects that are being studied.

However, the researchers found that, when dealing with a [discrete](#) , running variable, these commonly used CIs may not perform well and may not accurately represent the true uncertainty related to the estimated treatment effects. To address this issue and provide a more reliable approach for researchers, the project team developed two new CIs that can help researchers make more accurate assessments of causal effects.

Accuracy ensured

The RDD approach works with two groups of individuals - a treatment group that receives the intervention and a control group that does not. Participants are grouped based on a [cutoff point](#) , in the running variable. Comparing outcomes on either side of the cutoff point helps infer the treatment's causal effect.

However, in RDD, there is a risk that individuals might deliberately change certain aspects of themselves or their behaviour in order to influence which treatment group they are assigned to. This could undermine the credibility and validity of the RDD approach.

Therefore, to overcome this potential problem and ensure the accuracy of RDD analysis, the third part of the project was dedicated to developing methods for estimation and drawing conclusions that can account for manipulation in RDD studies. The team established a broad framework to address the issue of manipulation, using nonparametric statistical methods, while also considering additional aspects of the manipulation scenario.

For more details on the methods developed, there are three publications available on the [results page](#) of the project.

Keywords

RD-ADVANCE, regression discontinuity design, causal effects, AI, economics, observational data, machine learning, policy advice

Project Information

RD-ADVANCE

Grant agreement ID: 772021

DOI

[10.3030/772021](#) 

Closed project

EC signature date

23 February 2018

Funded under

EXCELLENT SCIENCE - European Research
Council (ERC)

Total cost

€ 878 970,00

EU contribution

€ 878 970,00

Coordinated by

UNIVERSITÄT MANNHEIM
Germany

Start date

1 September 2018

End date

28 February 2023

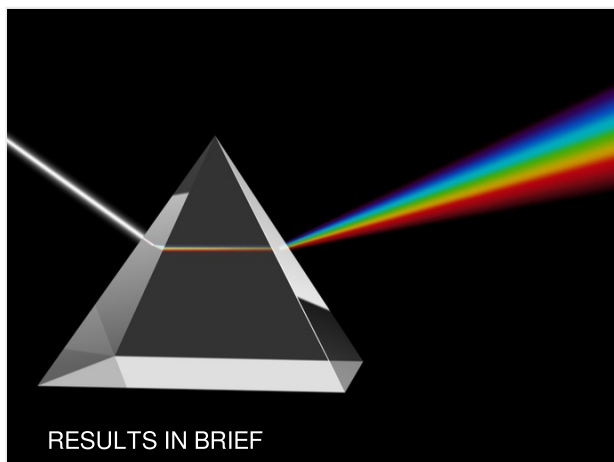
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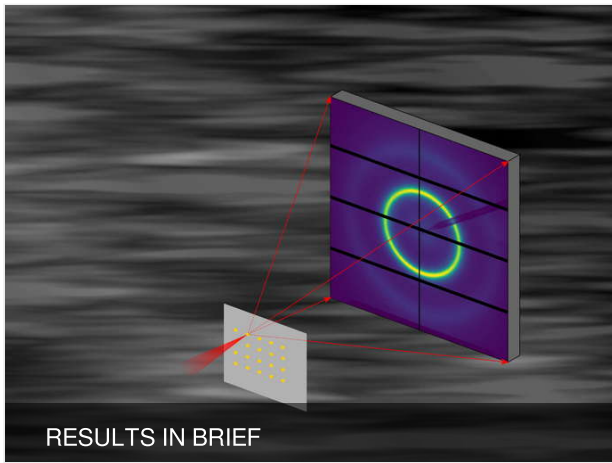


NEW PRODUCTS AND TECHNOLOGIES

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30 June 2021



Long-range anisotropy in a metallic glass



26 January 2024

Last update: 25 August 2023

Permalink: <https://cordis.europa.eu/article/id/446040-machine-learning-improves-the-estimation-of-the-causal-effects-in-regression-discontinuit>

European Union, 2024

Functionally scaled computing technology: From novel devices to non-von Neumann architectures and algorithms for a connected intelligent world

Results in Brief

Defining the future of information processing and memory technology

With the support of EU funding, researchers developed new forms of computer hardware ready to answer the demands of big data and artificial intelligence.



DIGITAL ECONOMY



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The future of information processing and memory technology is being shaped by the internet of things and big data.

“The ever increasing demands of ubiquitous computing requires small, flexible, power-efficient connected devices,” says C. David Wright, a professor of Electronic and Computer Engineering at the [University of Exeter](#) .

“While the rise of big data is pushing us to develop faster, less power-hungry, and more intelligent hardware and software processing that will let us extract and utilise relevant information from this abundant data.”

Answering both demands is the EU-funded [Fun-COMP](#)  project.

Computing in the age of AI

The goal of the project was to develop new forms of computer hardware suited to the age of big data and artificial intelligence (AI). “Our aim was to develop a new wave of industry-relevant technologies capable of extending the limits facing mainstream processing and storage approaches,” explains Wright, who served as the project coordinator.

To accomplish this, researchers focused on nanophotonics, or the use of devices and systems for manipulating light at the nanoscale.

According to Wright, the innovative nanophotonic devices and systems developed during the Fun-COMP project fuse together the core information processing tasks of computing and memory. They also incorporate in hardware the ability to learn, adapt and evolve.

“By designing solutions from the bottom up, we were able to take advantage of the huge benefits, in terms of increases in speed and bandwidth and reduction in power consumption, promised by the emergence of silicon photonic systems,” adds Wright.

Processing at the speed of light

One of those solutions is an entirely new form of photonic co-processor, also known as a tensor processor unit, or TPU. “This TPU can carry out the matrix-vector multiplications used by AI at speeds orders of magnitude faster than today’s state-of-the-art special purpose electronic processors,” notes Harish Bhaskaran, a professor at the [University of Oxford](#) , a key Fun-COMP partner.

Researchers also successfully developed the first-ever, all-optical phase-change spiking neurosynaptic photonic processing chip. By incorporating interconnected hardware photonic neurons and synapses, the chip can conduct both supervised and unsupervised learning.

Another important outcome was a novel photonic correlation processor that can be used for unsupervised correlation detection on real-world data streams.

“This processor could prove very useful for such tasks as social media analysis, financial forecasting, and detecting anomalies in data centres,” remarks Abu Sebastian, a researcher at [IBM Zurich](#) , one of the project’s main industrial partners.

World-leading innovation

Together, these outcomes have firmly placed integrated phase-change photonics as a ‘hot’ research field for the development of future computing and communication technologies.

“Thanks in part to the exciting results coming out of the Fun-COMP project, leading research groups from around the world are now working in this field,” concludes Wright.

Governments are also investing in the field. In fact, Wright and other researchers involved in the Fun-COMP project are now further developing the photonic TPU hardware via the EU-funded [Phoenixics](#), project, which is led by Wolfram Pernice, a professor at [Heidelberg University](#).

Other Fun-COMP partners and researchers have established the Oxford-based spin-off company [Salience Labs](#), which is working to commercialise some of the project’s ideas.

Fun-COMP’s results have also been presented at 38 conferences and published in 41 journal papers, including such prestigious titles as [‘Nature’](#), [‘Nature Nanotechnology’](#), [‘Science Advances’](#), and [‘Optica’](#).

Keywords

Fun-COMP, technologies, information processing, memory technology, computer hardware, big data, artificial intelligence, AI, internet of things, connected devices, software, nanophotonics, tensor processor unit

Project Information

Fun-COMP

Grant agreement ID: 780848



DOI

[10.3030/780848](#)

Closed project

EC signature date

23 November 2017

Start date

1 March 2018

End date

31 August 2022

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

Total cost

€ 3 996 951,25

EU contribution

€ 3 996 951,25

Coordinated by

THE UNIVERSITY OF EXETER

 United Kingdom

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30 July 2021

Last update: 20 January 2023

Permalink: <https://cordis.europa.eu/article/id/442778-defining-the-future-of-information-processing-and-memory-technology>

European Union, 2024

Seamless and safe human - centred robotic applications for novel collaborative workplaces

Results in Brief

Collaborative robots work like humans, with humans

Seamless human-robot collaboration supported by smart mechatronics and AI-based perception exceeds performance targets and inspires team spirit.



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Industry 4.0 is revolutionising manufacturing, but exploiting its full potential will only be possible when humans and robots work together, with technology actively supporting humans' leading role. The EU funded [SHERLOCK](#)  project has overcome critical challenges to widespread deployment of human robot collaboration (HRC). Its innovative robotic technologies with smart [mechatronics](#)  and AI-based cognition make safe, efficient and highly effective HRC possible.

Human-robot collaboration: teamwork makes the dream work

No one size fits all when it comes to industrial application of HRC. Combining components of SHERLOCK's incredible toolbox of technologies enabled solutions for

four industrial applications to exceed performance targets.

SHERLOCK enhanced the first-ever high-payload collaborative robot, validated manipulating heavy solar panels while using AI to adapt its behaviour when presenting parts to the operator.

“Cycle time was reduced by approximately 18 %, and the maximum weight handled by an operator went from 42 kg previously (requiring two operators) to 2 kg,” explains Nikos Dimitropoulos of the [Laboratory for Manufacturing Systems and Automation](#) (LMS) at the University of Patras in Greece and project coordinator. “The high-payload robot will thus support inclusivity,” he notes, “reducing employment barriers faced by operators with physical limitations.”

Sotiris Makris, head of the Robots, Automation and Virtual Reality in Manufacturing group at LMS, continues: “Our low-payload collaborative robot supported by an unparalleled advanced digital twin can perform real-time task planning using integrated data from distributed sensors. Our robot undertook riveting during industrial modules assembly, with the operator working on the same piece simultaneously thanks to SHERLOCK’s safety innovations.” The robot’s AI perception module detected about half of the most common assembly errors, and cycle time was reduced by about 40 %.

SHERLOCK’s semi-active exoskeleton with AI-driven robotic perception of human actions can automatically modulate its assistance in real time. The exoskeleton provides VR-based training for new operators and AR-based operator instructions. Its use reduced errors in the assembly of large computer numerical control machines.

Finally, “SHERLOCK’s mobile two-armed robot was employed for collaborative transport of large composite aerospace parts. Advanced impedance control and intuitive AR interfaces allowed the robot to effortlessly follow and assist the operator’s movement,” explains Makris. The solution reduced the number of operators required to move the large parts, freeing them to focus on other value-added activities.

AI-driven human-like robot behaviour and easy programming foster human acceptance

SHERLOCK demonstrated clear gains in performance, ergonomics and operator acceptance relative to previous HRC applications. “In four industrial scenarios, the SHERLOCK robots perceived the environment and the needs and preferences of the operators, predicted human intention and adapted their behaviour accordingly thanks to AI-driven perception and decision-making. Operators went from curious to enthusiastic, ultimately seeing the robots as valued co-workers,” notes Dimitropoulos.

The robots were even easier to programme than anticipated, enabling production engineers to reconfigure systems in hours instead of days without previous knowledge or training. Ease of programming and substantial assistance to operators will reduce many age, gender, physical and training barriers to employment.

SHERLOCK has revealed the real-world potential of highly intelligent, assistive robotic systems. HRC has moved from research to application, with three products released during the project’s lifetime. The team will continue maturation of key outcomes in the [CONVERGING](#) project.

Keywords

SHERLOCK, robot, AI, HRC, human-robot collaboration, manufacturing, exoskeleton, AR, mechatronics, VR

Project Information

SHERLOCK

Grant agreement ID: 820689



DOI

[10.3030/820689](https://doi.org/10.3030/820689)

Closed project

EC signature date

3 August 2018

Start date

1 October 2018

End date

30 September 2022

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Advanced manufacturing and processing
Technologies for Factories of the Future

Total cost

€ 7 939 022,50

EU contribution

€ 7 939 022,50

Coordinated by

PANEPÍSTIMIO PATRON



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28 April 2023

Last update: 3 February 2023

Permalink: <https://cordis.europa.eu/article/id/442850-collaborative-robots-work-like-humans-with-humans>

European Union, 2024

PROGnostics based Reliability Analysis for Maintenance Scheduling

Results in Brief

Bringing predictive maintenance to the factory floor

A new tool uses smart algorithms, artificial intelligence, and data analysis to predict the remaining useful life of a part or piece of equipment.



DIGITAL ECONOMY



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The modern-day factory is a complex, often high-tech environment. Assembly lines comprise a range of equipment and components, each of which performs a specific task in a given order. An issue with just one component can throw a wrench into the works, bringing the entire manufacturing process to a screeching halt.

Such stoppages are extremely expensive, so factories place a significant emphasis – and budget – on maintenance. The problem is that

most maintenance activities are either routine, meaning they happen regardless of whether a piece of equipment needs fixing, or reactive, meaning they happen after something breaks down. Although both approaches help reduce the risk of a lengthy shutdown, neither does a very good job at preventing the shutdown in the first place.

What factories need is predictive maintenance – which is exactly what the EU-funded [PROGRAMS](#) (PROGnostics based Reliability Analysis for Maintenance Scheduling) project aims to provide.

“We intend to extract information from every factory level – controllers and sensor data, maintenance reports, operator experience, physical characteristics, etc. – and, using an artificial intelligence-based algorithm, determine the optimal scheduling of maintenance activities,” says project coordinator Sotiris Makris, who heads the [Robotics, Automation and Virtual Reality](#), unit of the [University of Patras](#), [Laboratory for Manufacturing Systems and Automation](#) in Greece. “By minimising the impact that maintenance activities have on the production plan, we can help increase productivity and decrease costs.”

A game changer in predictive maintenance

The project’s defining outcome is the development of an innovative tool for predicting a part’s remaining useful life (RUL). “Using smart algorithms that exploit AI-based models and data collected from the field, this tool is nothing short of a game changer in predictive maintenance,” notes Makris.

According to Makris, knowing a part’s RUL allows a company to make short- and long-term capital expense calculations. “Such information supports decision-making on ordering spare parts or scheduling maintenance activities,” he adds. “It can also be used to ensure that personnel are properly trained on performing a specific maintenance task.”

In developing the tool, researchers faced a unique challenge. “Surprisingly, no breakdowns occurred during the project period, meaning we didn’t have any data on breakdown cases to feed into our AI algorithm,” explains Makris.

Instead, the project used AI-based models to simulate the underperforming status of the equipment. “Machinery breakdown is preceded by some deterioration in performance and a resulting decrease in product quality,” adds Makris. “This adjustment was actually very welcomed by our industrial partners as it allows them to avoid not only a breakdown, but also the preceding decrease in performance.”

An important milestone

The project is now working to advance the maturity of its tool and move it towards commercialisation. “Our ultimate goal is to prepare robust, AI-based predictive maintenance solutions that can be integrated into industrial applications,” notes Makris.

Achieving this goal has been made easier thanks in part to the project being a member of the [ForeSee Cluster](#), a network of six EU-funded projects working on predictive maintenance technologies.

“Our participation in the cluster has been an important milestone for the project,” concludes Makris. “Not only does it ensure that our results are incorporated into standardisation efforts, it also introduces us to an array of stakeholders who can use our work as a foundation for their own research.”

Keywords

PROGRAMS, predictive maintenance, maintenance, factory, smart algorithms, artificial intelligence, AI, data analysis, remaining useful life, assembly lines, manufacturing, industrial applications

Project Information

PROGRAMS

Grant agreement ID: 767287



DOI

[10.3030/767287](https://doi.org/10.3030/767287) 

Closed project

EC signature date

11 July 2017

Start date

1 October 2017

End date

31 March 2021

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Advanced manufacturing and processing

Technologies for Factories of the Future

Total cost

€ 5 995 272,50

EU contribution

€ 4 847 697,50

Coordinated by

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30 July 2021

Last update: 22 November 2021

Permalink: <https://cordis.europa.eu/article/id/435256-bringing-predictive-maintenance-to-the-factory-floor>

European Union, 2024

Enhanced data management techniques for real time logistics planning and scheduling

Results in Brief

AI to future-proof the global supply chain

The EU-funded LOGISTAR project reveals how automation, artificial intelligence, and data could be the key to optimising logistics operations within global supply chains.



DIGITAL ECONOMY



TRANSPORT AND
MOBILITY



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Efficient supply chains are the backbone of the world economy. But as the COVID-19 pandemic made clear, global supply chains can easily be disrupted. That's why, as we slowly segue into a post-pandemic world, it is essential that we work to better protect them against future disruptions.

“Global economic growth has put a significant strain on our very limited logistics infrastructure,” says [Enrique Onieva](#), a professor in Computing and Intelligent

Systems at the [University of Deusto](#) in Spain. “The efficient use of this infrastructure and of available transportation resources is a critically important goal.”

This is where the project [LOGISTAR](#) (Enhanced data management techniques for real time logistics planning and scheduling) comes in. “By taking advantage of the increasingly real-time data gathered from the interconnected environment, the LOGISTAR project aims to clear the way towards the effective planning of transport

operations within the supply chain,” adds Onieva, who serves as the project coordinator.

An end-to-end architecture

The main outcome of the project is an end-to-end architecture that can automatically capture and harmonise data, send the corresponding messages to the modules in charge of executing different algorithms, and gather results to be displayed to stakeholders.

“This solution takes real-time available data and feeds it to AI-based algorithms,” explains Onieva. “These algorithms are then used to run a number of services, each of which is geared towards optimising supply chain operations.”

For example, one service uses precise estimated time of arrival prediction and incident detection to optimise warehouse operations. “By helping warehouses use their available resources more efficiently, this service reduces wait times and the supply chain bottlenecks such delays cause,” adds Onieva.

Another service improves how freight is routed and load capacity optimised. “By taking advantage of different modes of transportation, such as trucks, trains and ships, we’re able to both optimise the use of all available infrastructure while also reducing the overall costs of logistics transport,” he notes.

On this note, the project also developed a tool for horizontal collaborative planning. “By helping different supply chain stakeholders share available resources, we can reduce the number of kilometres travelled by empty trucks, which in turn reduces greenhouse gas emissions,” says Onieva.

Practical answers to real problems

Onieva says COVID-19 didn’t just disrupt supply chains, it also impacted research projects like LOGISTAR. “The pandemic struck just as we were about to start our test activities, forcing us to conduct everything remotely,” he explains.

Despite this unforeseen challenge, the project succeeded at providing practical answers to real supply chain problems. “Our success is a direct result of the commitment of all the people involved in this project,” concludes Onieva. “We may have been a large team coming from different backgrounds and sectors, but we all shared the same objective of future-proofing our global supply chains.”

Although the project is now finished, Onieva and some of the project’s other partners

are working to improve the technology readiness level of LOGISTAR services. The end goal is to advance the technology towards commercialisation.

Keywords

LOGISTAR, supply chain, automation, artificial intelligence, AI, data, logistics, infrastructure, transportation, algorithm, warehouse

Project Information

LOGISTAR

Grant agreement ID: 769142



DOI

10.3030/769142 

Closed project

EC signature date

18 May 2018

Start date

1 June 2018

End date

30 September 2021

Funded under

SOCIETAL CHALLENGES - Smart, Green And Integrated Transport

Total cost

€ 4 997 548,75

EU contribution

€ 4 997 548,75

Coordinated by

UNIVERSIDAD DE LA IGLESIA DE
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Spain

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27 September 2023

Last update: 22 November 2021

Permalink: <https://cordis.europa.eu/article/id/435255-ai-to-future-proof-the-global-supply-chain>

Smart Tools for Gauging Nano Hazards

Results in Brief

A novel toolbox supports rational design of nanomaterials for safe use

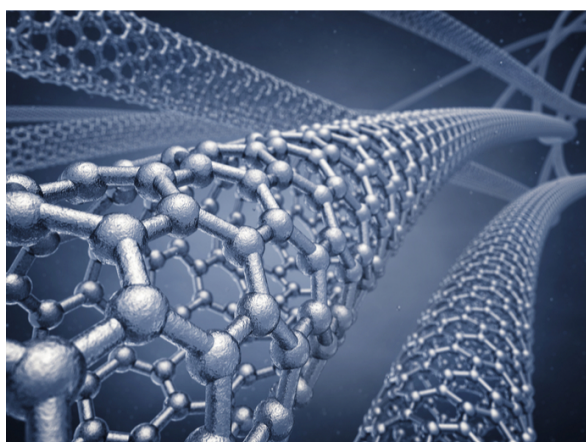
Despite several decades of research, understanding of the mechanisms of nanomaterial toxicity and its integration in safety assessments was still quite limited. A breakthrough is helping scientists predict the development of diseases based on a nanomaterial's physicochemical properties.



SECURITY



HEALTH



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Nanomaterials are a diverse, virtually limitless class of materials that vary in composition and physicochemical attributes. Their common feature is their small size. This gives them their unique and often exotic properties but poses a challenge in terms of protecting people and the environment throughout the materials' life cycle.

The current safety screening procedures are expensive and time consuming and often include animal experiments. The EU-funded

[SmartNanoTox](#)  project has developed a simpler and faster way to predict the specific nanotoxic effects a given material might have, even before it is used in products.

Two sides of the same coin

SmartNanoTox analysed an organism's state over time following exposure in the lung to different nanomaterials and developed flowcharts showing how the biological responses to toxicity progress, referred to as the [adverse outcome pathways](#) (AOPs). Scientists also followed the state of nanoparticles in the exposed tissues using high resolution imaging, chemical analysis and computer simulation.

After mapping one onto the other, they determined which molecular interactions triggered specific, rather simple biological events – for example, misfolding of a protein, membrane disruption, catalysis of a chemical reaction or cell penetration. Machine learning and statistical models helped connect the biological toxicity data to the physicochemical description (for example, long rigid needles versus chemically aggressive, small, insoluble particles).

Nothing left to chance

The AOP framework describes causal linkages between a molecular initiating event, a series of intermediate key events and the adverse outcome. The team aimed to describe several independent pathways leading to serious diseases. However, they were surprised to find how interconnected the AOPs were, with several adverse outcomes sharing similar intermediate key events. The insight added up to a significantly enhanced predictive ability.

Project coordinator Vladimir Lobaskin of University College Dublin explains: “For the first time, we can directly connect a nanomaterial's measured or computed properties to the key steps of disease development and predict whether the specific material is likely to cause fibrosis, cardiovascular problems or cancer.” SmartNanoTox used the powerful, new safety assessment paradigm to show that a chronic lung inflammation caused by nanoparticles could be understood in detail and predicted using tests on cell cultures and computer simulation without actual animal experiments. The results have been [published in Advanced Materials](#). Further, the team showed that this chronic condition can be caused by a single exposure to certain biopersistent materials.

Predicting chronic disease with in vitro and in silico tools

[In vitro aerosol exposure test systems](#) and [sensorial cellular devices harnessing tissue-on-chip technology](#) are available from partners. Other tools are available in freely accessible databases or open-source software repositories, including [NanoCommons KnowledgeBase](#), the AOP-Wiki and the Gene Expression Omnibus.

“Our unique effort linking physics, chemistry and biology to medicine has connected the elementary structures of nanomaterials to their biological actions. With this, we

demonstrated that it is possible to predict chronic health conditions resulting from nanomaterial exposure with simple in vitro tests and computer simulation,” Lobaskin concludes. The SmartNanoTox tools will have a far-reaching impact on any application of nanomaterials that can affect living systems at any point in their life cycle.

Keywords

SmartNanoTox, nanomaterial, AOP, physicochemical, toxicity, safety assessment, nanoparticle, biopersistent, adverse outcome pathway

Project Information

SmartNanoTox

Grant agreement ID: 686098



DOI

[10.3030/686098](https://doi.org/10.3030/686098)

Closed project

EC signature date

26 February 2016

Start date

1 March 2016

End date

30 September 2020

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies – Nanotechnologies

Ensuring the safe and sustainable development and application of nanotechnologies

Total cost

€ 8 147 304,88

EU contribution

€ 7 996 124,25

Coordinated by

UNIVERSITY COLLEGE DUBLIN,
NATIONAL UNIVERSITY OF IRELAND, DUBLIN

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Tech approach puts dementia patients' needs first



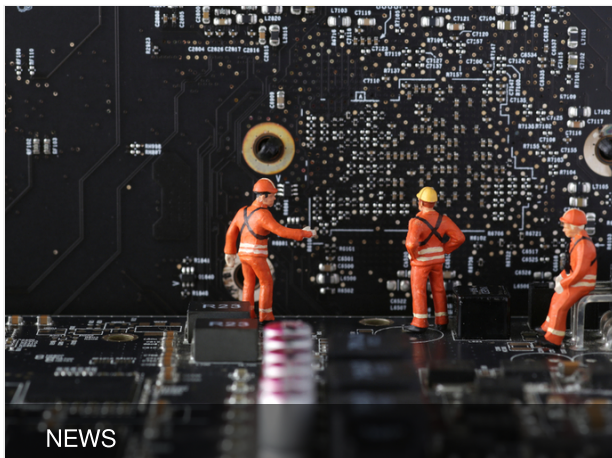
8 December 2023



Fighting the epidemic of pain



5 September 2023



PROJECT OF THE MONTH

Exploring how social media and crowdsourcing can contribute to more disaster-resilient societies



30 July 2021

Last update: 1 April 2021

Permalink: <https://cordis.europa.eu/article/id/429517-a-novel-toolbox-supports-rational-design-of-nanomaterials-for-safe-use>

European Union, 2024

AuThoring tooL for indoor Augmented and dimiNished realiTy experiences

Results in Brief

Augmented reality takes the guesswork out of interior design

The ATLANTIS project's user-friendly augmented reality system takes the strain out of rearranging interior spaces. Customers and design professionals can now plan better, realistically visualising outcomes.



DIGITAL ECONOMY



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In the coming years, virtual reality (VR) and augmented reality (AR) will likely have a significant impact on many areas of everyday life. In interior design, AR could help customers and design professionals visualise how modifications to furnishings will change the appearance of spaces.

Yet there are barriers to it taking off.

“We’ve seen a lot of announcements about indoor AR planning and design tools recently, but many are tied exclusively to products from particular large companies,” says Georg Thallinger, project coordinator of the [ATLANTIS](#) project. “Another challenge has been digitising indoor environments, with some tools relying on users doing it themselves.”

Building on a business case from project partner [Roomle](#), ATLANTIS took advantage of progress in scanning technology, to create a solution that links to any

company's catalogue items, customisable to specific needs.

“Our solution opens up the AR market to smaller, more niche companies, helping these businesses grow, while giving customers more choice and control,” explains Thallinger from [Joanneum Research](#), the project host.

As well as launching a prototype, ATLANTIS has made some software components available as [open-source tools](#), while also adding to existing [indoor scene data sets](#).

Scene authoring

The inspiration for the project was twofold. Firstly, most room planning AR-based apps require users themselves to draw a floor plan. Secondly, the visualisation of virtual items inserted often clashes with real objects in the room.

The challenge was to digitally represent the interaction zone both on-site (using AR) and off-site (using VR). This required estimations of room layouts (edges between floor, walls and ceiling) and the object's distance to cameras.

“The 3D modelling tools that create the visualisations have complex user interfaces; we wanted to hide this complexity from users,” adds Thallinger.

To simplify scene authoring, ATLANTIS takes a single panoramic image from which it reconstructs room geometry and scene components – objects in the room – delineating these from other objects and the background.

To enable digital interaction, objects have to be mapped (their boundaries recorded) and classified, according to type. This means that to remove an object, a user simply selects it, without having to manually draw a border around it.

If a user digitally removes an object, an AI-driven technology known as diminished reality (DR), [‘inpaints’](#) to calculate what would be remaining in view.

“While digital removal existed before, we enable it with one tap and with groups of objects. Our inpainting also ensures that once objects are removed, the room remains geometrically accurate, making it more visually realistic,” explains Thallinger.

ATLANTIS followed a user-centred approach, starting with stakeholder interviews in the design phases, which led to prototypes. These were then continually tested with potential users, including in two larger task-based evaluations. One with an intermediate version of the prototype, the other with a close to final version, each

involving at least 24 users.

“We compared our system against three alternative tools, finding that the prototype did well for task efficiency and user satisfaction. We also arranged guided walkthroughs with professionals, getting positive feedback,” says Thallinger.

Boosting business models

In setting realistic customer expectations, the ATLANTIS AR app saves businesses and consumers time and money by avoiding later changes. New digital workflows such as this will also help SMEs grow their business, offering valuable data which could be used for marketing purposes, for example.

The team will now incrementally integrate their technology within Roomle’s products and services, while assessing customer feedback. The ultimate goal is to develop a commercial solution based on Roomle’s full product range.

Keywords

ATLANTIS, augmented reality, AR, interior design, authoring tool, app, inpaint, diminished reality, DR

Project Information

ATLANTIS

Grant agreement ID: 951900



DOI

[10.3030/951900](https://doi.org/10.3030/951900)

Closed project

EC signature date

20 May 2020

Start date

1 July 2020

End date

30 June 2022

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

Total cost

€ 1 756 768,75

EU contribution

€ 1 507 200,63

Coordinated by

JOANNEUM RESEARCH
FORSCHUNGSGESELLSCHAFT
MBH

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9 June 2023

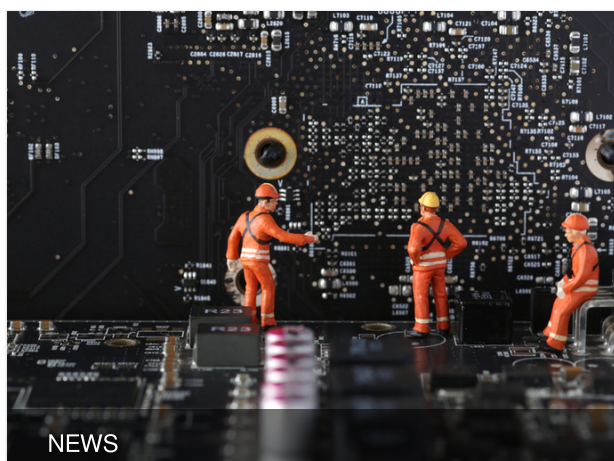


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4 May 2023



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Exploring how social media and crowdsourcing can contribute to more disaster-resilient societies



30 July 2021

Last update: 4 November 2022

Permalink: <https://cordis.europa.eu/article/id/442443-augmented-reality-takes-the-guesswork-out-of-interior-design>



Incorporating Requirements of People with Special Needs or Impairments to Internet-based Systems and Services

Results in Brief

Software tools for easier design usability

Today it is widely recognized that technological advancements and the global economy have altered the business and social environment. These changes mainly encompass the transformation of industrial economies and societies into knowledge and information-based service economies. In this environment, it is essential that everybody, regardless of special needs or impairments, will be able to participate in the information society.



DIGITAL ECONOMY



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The requirement for accessibility and modalities adapted to user preferences has led to increased awareness regarding the system designs with emphasis on usability and respect to the needs of people with disabilities and older people. In this light, product development is guided by a user-centered design philosophy aiming at giving applications which are fit for the purpose for which they were designed.

USERfit methodology was developed within the USER European project and comprises a set of nine summary tools designed to assist developers in addressing the issue of usability in design. The central concept of USERfit methodology is usability, in other words the creation of products and systems that are effective, efficient, safe and comfortable for the user.

From this perspective user requirement and capabilities comprise the main drive for product development as opposed to technological capabilities. The methodology follows the common design activities which are the definition of the task (context of use and user analysis), the development of a functional specification, application building using the findings and testing the product via usability evaluation tools. However, the design related information is stored and propagated through paper-based forms, which could make the specification process tedious.

The USERfit Tool was created within IRIS project in order to facilitate the use of the USERfit design environment. IRIS (Incorporating Requirements of People with Special Needs or Impairments to Internet-based Systems and Services) aimed to design architecture and develop and validate a design aid environment to facilitate the use of design-for-all tools and methods. USERfit Tools automates many parts of USERfit methodology eliminating the need for large numbers of paper forms. The protocols defined by USERfit method are accurately reproduced while previous specification may be reused. Furthermore, remote groups are now able to share the design parameters enabling more homogeneous outcomes.

USERfit proved through usability analysis to fulfil the needs and working styles of designers. However there is always scope for further development using USERfit as a platform for user-centred design of systems' interfaces.

Project Information

IRIS

Grant agreement ID: IST-2000-26211

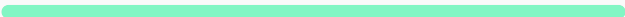


Start date

1 January 2001

End date

31 October 2003



Funded under

Programme for research, technological development and demonstration on a "User-friendly information society, 1998-2002"

Total cost

€ 1 770 647,00

EU contribution

€ 1 146 213,00

Coordinated by
EUROPEAN DYNAMICS
ADVANCED SYSTEMS OF
TELECOMMUNICATIONS
INFORMATICS AND
TELEMATICS S.A.



Greece

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9 June 2023

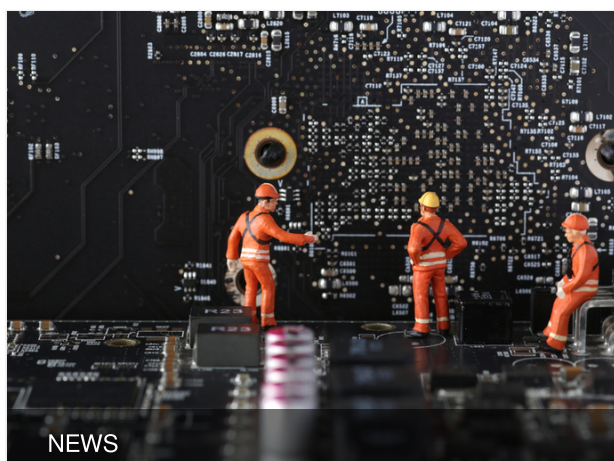


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4 May 2023



PROJECT OF THE MONTH

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30 July 2021

Last update: 17 July 2006

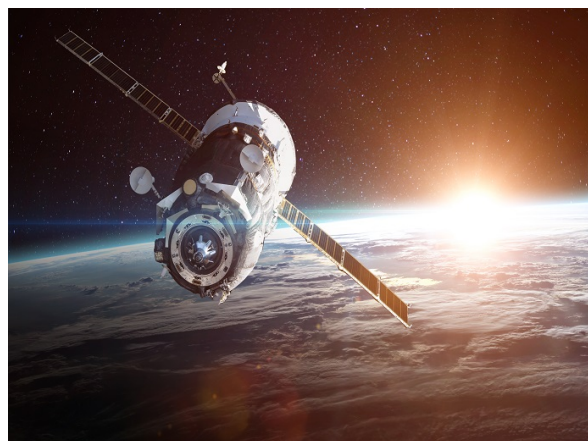
Permalink: <https://cordis.europa.eu/article/id/82700-software-tools-for-easier-design-usability>.

Innovative Coarsening-resistant Alloys with enhanced Radiation tolerance and Ultra-fine -grained Structure for aerospace application

Results in Brief

Computing power focused on nanoscale grains identifies high-performance alloys for space

Today's aerospace engineers support missions of complexity far beyond that of Daedalus and Icarus and their flight to escape the walls of the Minotaur's labyrinth. A novel computational high-throughput screening tool will help them design the high-performance alloys their missions need.



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Above the insulating atmosphere of the Earth, satellites and spacecraft encounter very harsh environments of extreme heat or cold and damaging radiation. Advanced materials and associated manufacturing processes are required for the long-term integrity of space systems and the safety of astronauts.

Given the practically infinite variety of materials, the power of computational modelling is critical to development. The EU-funded [ICARUS](#)  project developed the numerical tools to design thermodynamically stable nanocrystalline metal alloys and demonstrated their utility in selected materials of interest to aerospace applications.

Stabilising the nanocrystalline structure of the alloys

Alloys, metallic substances made of two or more elements, are widely used in the aerospace industry to integrate the best properties of individual metals. Coarsening, intuitively like the production of larger coarser grains (crystallites or tiny crystals) leading to larger pores in between the grains, is an important consideration when using nanocrystalline alloys. Grain boundaries are key to coarsening by increasing the excess Gibbs free energy (G) of the system. Grain growth is a consequence of the thermodynamic driving force to reduce this excess. Thermodynamic stabilisation eliminates the driving force, and thus grain growth and coarsening, through appropriate selection of alloys.

High-throughput screening zeroes in on the best candidates

While thermodynamic stabilisation is simple in concept, project coordinator Nicolas A. Cordero illustrates its complexity in practice: “Consider the case of binary alloys (made of two elements). If we select just 10 interesting majority elements and 5 interesting minority elements, we have 50 possible combinations. If we want to investigate 10 different percentage compositions and test their thermal stability at 10 temperatures for each of them, we end up with 5 000 systems and conditions to be experimentally investigated!” ICARUS developed a high-throughput screening tool to solve this problem.

Overcoming the challenges of combining classical and statistical thermodynamics, ICARUS delivered a unified model enabling the exploration of the Gibbs free energy surface. It can identify thermodynamically stable nanocrystalline alloys based on known physical and chemical data. Fabrication of candidate specimens enabled validation of the model as well as improvement of current techniques for nanocrystalline powder creation and the sintering of solid pieces.

ICARUS’ innovation takes flight

ICARUS’ high-throughput screening tool will enable engineers to deliver nanocrystalline alloys satisfying important goals of the [Advisory Council for Aviation Research and Innovation in Europe](#) . These include enhanced radiation resistance via self-healing mechanisms, enhanced thermal resistance thanks to high heat conduction and low thermal expansion, and, lastly, high mechanical strength combining low weight with high performance for lower fuel consumption.

Outcomes are being distributed in numerous ways including through social media pages. [videos](#) , [leaflets and posters](#) , and [newsletters](#)  as well as two

workshops, participation in a number of scientific [conferences](#), and open-access [scientific publications](#).

Cordero summarises: “ICARUS delivered computational tools that can predict the thermal stability of nanostructured alloys, providing a practical way to screen suitable alloys for experimental testing. Only this interplay of theory and experiment can produce the innovative materials required of present and future space applications.” A parallel project, [ICARUS-SW](#), is now underway to pave the way for exploitation of the ICARUS code.

Keywords

ICARUS, alloys, nanocrystalline, thermal, coarsening, grain, aerospace, thermodynamic, computational, high-throughput screening, Gibbs free energy, radiation, space, sintering, powder

Project Information

ICARUS

Grant agreement ID: 713514



DOI

[10.3030/713514](#)

Closed project

EC signature date

16 May 2016

Start date

1 September 2016

End date

31 August 2019

Funded under

EXCELLENT SCIENCE - Future and Emerging Technologies (FET)

FET Open

Total cost

€ 2 698 062,50

EU contribution

€ 2 698 062,50

Coordinated by

UNIVERSIDAD DE BURGOS

 Spain

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30 December 2021



Xenon loses ground to more cost-efficient satellite fuel competitor



28 October 2022



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Take up the challenge to explore the moon's surface



20 October 2022

Last update: 24 April 2020

Permalink: <https://cordis.europa.eu/article/id/415890-computing-power-focused-on-nanoscale-grains-identifies-high-performance-alloys-for-space>

European Union, 2024

Inclusive Futures for Europe BEYOND the impacts of Industrie 4.0 and Digital Disruption

Results in Brief

Inclusive growth: ‘recipes for success’ beyond Industry 4.0

An analysis of technology’s impact on companies and the labour market has led to rapidly accelerating policy reform on EU, national and company levels.



DIGITAL ECONOMY



INDUSTRIAL
TECHNOLOGIES



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Industry 4.0 is the current ‘revolution’ in manufacturing. It relies on increasing digitisation, automation and data exchange through technologies including sensors, robotics, machine learning and AI. In line with the Internet of Things paradigm, Industry 4.0 focuses heavily on interconnectivity. The question of whether this ‘connected’ technology landscape inevitably leads to massive job losses is the subject of heated debate.

The historically low unemployment and high employment in Europe and beyond would suggest the answer is no. The EU-funded [BEYOND4.0](#) project set out to investigate the Industry 4.0 landscape. However, far more ambitious, the ultimate goal was to use insight to positively shape the social policy changes ahead, beyond 4.0.

Industry 4.0 for profit or inclusive growth: a tale of two companies

BEYOND4.0 investigated how companies deploy new technology in a way that creates jobs and inclusive growth. “We distinguished two types of companies: ‘learning organisations’ and organisations mainly out for quick profits. The former focus on creating learning workplaces – empowering employees with new knowledge – that foster product innovation and professional growth. The latter ensure profits – but mainly at the expense of employees and society. Research pointing to the risk of technology destroying workplaces concerns mainly the latter type of companies,” explains Steven Dhondt of the [Netherlands Organisation for Applied Scientific Research](#)  (TNO), scientific project coordinator.

“If we want the digital revolution to lead to more and better work, companies must design work such that employees are learning from it,” he adds. Proactive skills provision to staff is a success factor for industry’s contribution to building a sustainable and resilient society.

‘Interacting skills’ essential to digital transformation

Perhaps the most important finding was the gap in current policy thinking that underestimates non-digital skills in digital transformation. “Workers need not only technical skills but other skills such as methodological, social and problem-solving skills. These skills are not new but now they must be integrated with digital skills to address individual tasks. These ‘interacting skills’ are what is important,” notes Dhondt. Analysis of both skills and tasks and their interactions is necessary to identify emerging skills gaps – which skill categories are needed in combination to do individual tasks.

Social policies for a flourishing digital future

More than 40 policy publications and 5 books – see [Results/Publications](#) for some examples – are already generating impact. Among highlights, “our proposal on ‘workplace innovation’ has been included in two opinion papers of the European Economic and Social Committee, and the European Commission has asked us to help shape its [Industry 5.0](#)  policy,” explains project manager Peter Oeij, also of TNO. The consortium was invited by national governments and myriad organisations, many of whom are building on BEYOND4.0’s outcomes, to help shape innovation policy.

A proposed new framework for workers’ benefits, ‘participation income’, is now at the heart of Finland’s social security system reforms, an example closely followed by Italy

and the Netherlands. It will tie financial benefits to work and other activities ‘civil society’ deems of interest. This contrasts with current ‘work-focused benefits’ including universal basic income that are related to work generally rather than doing work that benefits society.

“Technology is not a threat to jobs but rather an opportunity for inclusive growth. Our future can and will be positive if companies and governments adjust their social policies to take advantage of these tremendous opportunities,” Dhondt concludes.

Keywords

BEYOND4.0, technology, Industry 4.0, policy, inclusive growth, jobs, social policies, Industry 5.0, employment, workplace innovation

Project Information

BEYOND4.0

Grant agreement ID: 822296



DOI

[10.3030/822296](#) 

Closed project

EC signature date

5 November 2018

Start date

1 January 2019

End date

30 June 2023

Funded under

SOCIETAL CHALLENGES - Europe In A Changing World - Inclusive, Innovative And Reflective Societies

The mechanisms to promote smart, sustainable and inclusive growth

Innovative societies

Total cost

€ 2 999 970,00

EU contribution

€ 2 999 970.00

Coordinated by
 NEDERLANDSE ORGANISATIE
 VOOR TOEGEPAST
 NATUURWETENSCHAPPELIJK
 ONDERZOEK TNO
 Netherlands

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15 June 2021



19 July 2023



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9 June 2023



NEW PRODUCTS AND TECHNOLOGIES

Harnessing the potential of grass to benefit small rural communities



9 March 2021



PROJECT OF THE MONTH

Exploring how social media and crowdsourcing can contribute to more disaster-resilient societies



30 July 2021

Last update: 18 July 2023

Permalink: <https://cordis.europa.eu/article/id/445190-inclusive-growth-recipes-for-success-beyond-industry-4-0>

European Union, 2024

Verification and Validation of Automated Systems' Safety and Security

Results in Brief

Verification and validation for complex automated systems

With automated systems becoming more interconnected, researchers have streamlined processes and diminished the time and expenses incurred in verifying and validating them.



DIGITAL ECONOMY



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In the realm of highly automated systems, the consequences of failures can be severe, often leading to catastrophic outcomes. As these systems become more intricate and interconnected, the emergence of unforeseen properties necessitates meticulous verification and validation (V&V). However, the complexity involved in this process makes it time-consuming and expensive.

The EU-funded [VALU3S](#) project, concluding in July 2023, undertook a pivotal role in evaluating cutting-edge V&V methods and tools for automated systems across various sectors including automotive, agriculture, healthcare, aerospace, railway, industrial automation and robotics.

Elevating safety and security

VALU3S' primary objective was to devise a multi-domain framework that addresses these escalating complexities by implementing, enhancing, and assessing V&V methods and tools – thus qualifying and quantifying safety, security and privacy aspects. By utilising demonstrators with specific safety, cybersecurity, and privacy requirements across these diverse domains, VALU3S aimed to streamline the V&V process and subsequently diminish the time and expenses incurred in verifying and validating automated systems.

Two significant results from the project stand out, according to Behrooz Sangchoolie, project coordinator of VALU3S. Firstly, over 40 distinct V&V tools were implemented, improved and evaluated. These tools played a pivotal role in achieving the core objective of minimising the time and costs associated with verifying and validating automated systems concerning safety and cybersecurity requirements.

Secondly, the creation of the VALU3S web-based repository served as a cornerstone. “The repository hosts pointers to some of the key results generated by the project e.g. the V&V methods and tools enhanced, the evaluation results connected to the project use cases, as well as the V&V workflow models generated using verification and validation modelling language (VVML) developed during the project,” adds Sangchoolie.

Demystifying V&V processes

One of the primary challenges revolved around harmonising V&V activities across domains that varied in maturity levels regarding V&V processes. However, this challenge was transformed into a strength, enabling the project to amalgamate insights from different domain-specific V&V processes.

“A significant number of the methods and tools developed in the project were also applied on use-cases introduced by some of the industrial project partners. This way we made sure that the solutions proposed in the project have real-world applications,” comments Sangchoolie.

Thirteen use-cases from six distinct domains formed the crux of demonstrators in the project. The application of developed technologies in these use cases led to the unveiling of over 20 demonstrators during the project's final event.

The project's success in structuring the components and elements necessary for V&V processes stemmed from an eight-dimensional V&V framework. This blueprint provided a clear delineation of essential elements required for effective V&V procedures.

State-of-the-art verification

While VALU3S has made substantial strides in advancing V&V methodologies, further avenues for exploration exist. Future endeavours encompass enhancing V&V tools through state-of-the-art machine learning models, targeting eco-friendly practices in V&V activities, transforming the VALU3S repository into a go-to platform for V&V stakeholders and contributing to the training of future engineers and practitioners in the domain. Nevertheless, the project sets the stage for a more efficient, cost-effective and safer landscape for highly automated systems across multiple industries.

Keywords

VALU3S, automated systems, safety and security, multi-domain framework, verification & validation

Project Information

VALU3S

Grant agreement ID: 876852



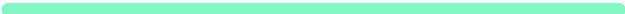
DOI
[10.3030/876852](https://doi.org/10.3030/876852)

Closed project

EC signature date
19 May 2020

Start date
1 May 2020

End date
31 July 2023



Funded under
INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)
ECSEL

Total cost
€ 25 620 958,68

EU contribution
€ 7 602 601,44

Coordinated by
RISE RESEARCH INSTITUTES
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RESULTS IN BRIEF

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9 June 2023

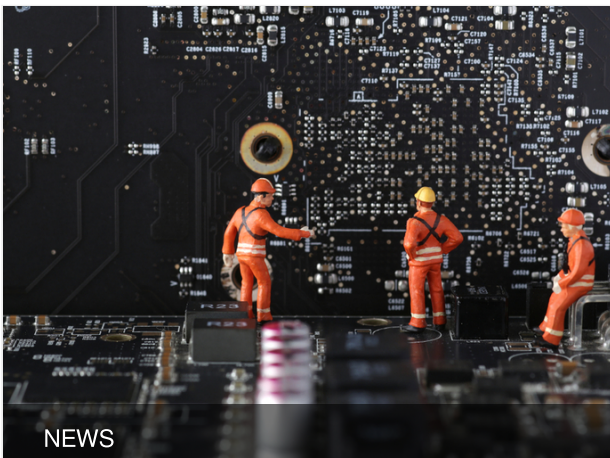


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4 May 2023



PROJECT OF THE MONTH

Exploring how social media and crowdsourcing can contribute to more disaster-resilient societies



30 July 2021

Last update: 8 December 2023

Permalink: <https://cordis.europa.eu/article/id/448102-verification-and-validation-for-complex-automated-systems>

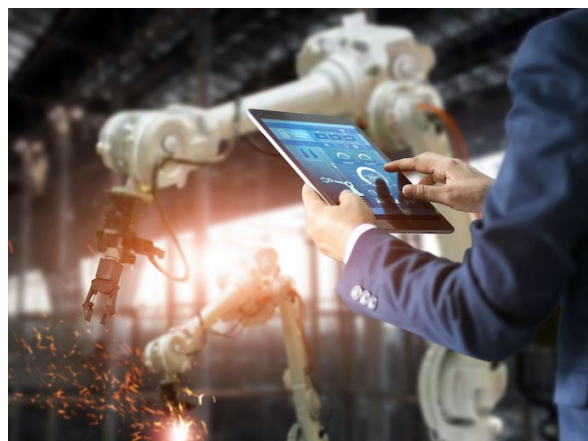
European Union, 2024

Virtual Factory Open Operating System

Results in Brief

A smart app creation space for virtual factories

An open operating system for virtual factories will allow software developers to create factory apps and boost European manufacturing.



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The fourth digital revolution is underway. Traditional factories across Europe and beyond are transforming into smart digital manufacturing environments.

Production systems are increasingly digitally connected within the confines of the building and through customers and across supply chains. This network of assets and connectivity is termed a 'virtual factory'. However, to enable such systems is still time-consuming and expensive due to the diverse equipment and the hardware/software knowledge necessary.

The goal of the www.vf-os.eu (vf-OS project) has been to create a Virtual Factory Operating System designed to aid in the creation of software applications to create virtual factories of the future. vf-OS, which ran from 2017 to 2019, aims to become a reference system software for managing factory-related computer hardware and software resources.

The vf-OS team expected to reach technology readiness level (TRL) 4 (meaning the

technology is validated in a lab), yet it surpassed expectations and delivered aspects above TRL 5 (technology validated in a relevant environment).

“The working prototypes were significantly more robust than expected,” says Stuart Campbell, Director and CEO at Information Catalyst and vf-OS project coordinator.

A modern toolkit

vf-OS created an Open Applications Development Kit, which is given to software developers to create the vf-OS apps (vApps). By creating this framework, app designers can quickly tailor software to the specific needs of each factory.

There is a marketplace in which these vApps can be purchased, sold and deployed without the constraints of physical and geographical barriers. “This vf-OS Store will be open to software developers who can quickly develop smart applications to enable, for example, sensing and sharing of information between machines and across the supply chain,” says Campbell.

Apps could be created to manage a variety of smart factory processes, improving overall efficiency and productivity. One such app could deal with data analysis from sensors throughout a factory, evaluating progress of machines in comparison to past trends, and predicting potential future failures. Another could be used at construction sites, to detect defective fresh concrete deliveries as early as possible.

Putting it into practice

Several pilots of vf-OS have been run so far, in which multiple vApps per pilot were developed and deployed for meeting individual factory needs.

In a manufacturing and assembly system pilot, vApps were tested to prevent and manage machine failures, establish stock refilling mechanisms and closely monitor production lines. In a construction site setting, vApps included site management, identification of steel bars, reporting and management of delays, and concrete quality checking.

vf-OS has produced an initial prototype of this mixed development and execution environment for smart manufacturing applications. Several assets, such as IoT devices, software packages (through APIs), analytics models and other external services (through third-party services) can be linked to or included in the core of each vApp.

vf-OS ideas and technology were also a cornerstone of another continuing project, www.zdmp.eu (Zero Defect Manufacturing Platform) (ZDMP), which started in 2019

and where the proposers could already see the solid work.

One of the main aims of vf-OS was to set up a company at the end which could exploit the technology. www.i4fs.com (Industry 4 Factory Solutions Ltd) (i4FS) was incorporated by several partners of the project in October 2019. In fact, several ZDMP partners also decided to take shares in this company as well.

“If the research and innovation of vf-OS can be further developed, EU manufacturing industry will have at their disposal new mechanisms to quickly develop smart applications for their own factory environments,” says Campbell.

Keywords

vf-OS, factory, open, system, operating, apps, vApps, sensors

Project Information

vf-OS

Grant agreement ID: 723710



DOI

[10.3030/723710](https://doi.org/10.3030/723710)

Closed project

EC signature date

22 July 2016

Start date

1 October 2016

End date

31 October 2019

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

Total cost

€ 7 758 580,00

EU contribution

€ 7 758 580,00

Coordinated by

INFORMATION CATALYST FOR ENTERPRISE LTD

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5 February 2024



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28 April 2023

Last update: 20 March 2020

Permalink: <https://cordis.europa.eu/article/id/415509-a-smart-app-creation-space-for-virtual-factories>

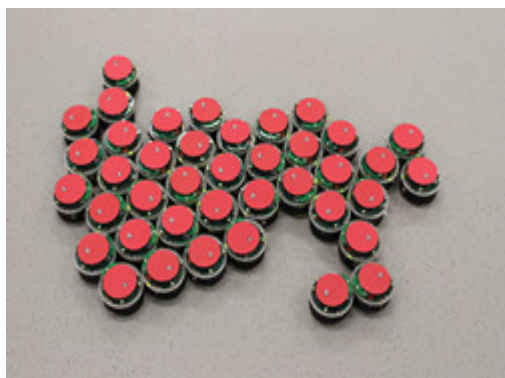
European Union, 2024

Autonomous evolution of robotic organisms

Results in Brief

Cooperative, self-organised robots

An EU-funded project developed an artificial intelligence system that allows tiny robots to replicate the collective behaviour of living beings.



© Visakan Kadiramanathan

Self-assembly of discrete and autonomous entities has led to the design of collectively acting modular robots. However, the capabilities of such systems are vastly unexplored mainly because of shortcomings in current hardware implementations.

The EU-funded project 'Autonomous evolution of robotic organisms' (EVOLVINGROBOT) addressed how complex patterns or structures can arise in systems of numerous interacting

robotic units. Researchers' designed a novel self-assembled system that is composed of macroscopic building blocks that float in an agitated medium. Its dynamics allow the blocks to physically bind with each other and disband. When comprising a large number of blocks, such systems could be used to study the emergence, reproduction and evolution of life-like organisms.

The breakthrough, allowing robots to act collectively in a way never achieved before, could herald a paradigm change in robotics. Rather than building robots of ever increasing complexity, the project suggested that extremely simple mechanisms can enable a range of potential capabilities. The process was governed solely by the

building blocks and their local interactions in the absence of any blueprint or central command. This made it possible to drive the system towards an organism population that is adapted to its environment.

EVOLVING ROBOT succeeded in getting miniature robots, acting autonomously on the basis of very simple pre-programming, to perform a number of collective tasks. These tasks included gathering together in a single place, segregating themselves into distinct sub-groups, cooperatively transporting objects, and cleaning up an area. Scientists found that none of them required the robots to communicate with each other. In addition, some tasks did not require them to have memory or be able to compute at all.

Furthermore, the project developed a series of prototype units that were able to harvest energy from the environment, and be able to control when and where to move. In addition, a self-folding, modular robot that is able to transform between two- and three-dimensional configurations was developed.

Project outcomes could pave the way for implementing massively distributed robotic systems at unprecedented scales that conventional sensing and information processing approaches cannot achieve.

Keywords

Robot, swarm robotics, collective behaviour, self-assembly, autonomous, life-like organism

Project Information

EVOLVINGROBOT

Grant agreement ID: 268354

Closed project

Start date

1 September 2010

End date

31 August 2013

Funded under

Specific programme "People" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Total cost

€ 45 000,00

EU contribution

€ 45 000,00

Coordinated by

THE UNIVERSITY OF SHEFFIELD

 United Kingdom

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5 February 2024



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5 February 2024



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28 April 2023

Last update: 9 June 2015

Permalink: <https://cordis.europa.eu/article/id/151505-cooperative-selforganised-robots>

European Union, 2024

Solving High Energy Physics Equations using Monte Carlo Gaming Techniques

Results in Brief

Game theory and AI offer more precise calculations for quantum physics

The increasing precision of experimental data coming from the world of quantum physics presents an enormous computational challenge for theoreticians. To meet this, the ERC-supported HEPGAME project has borrowed techniques from AI and gaming.



FUNDAMENTAL
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Quantum Field Theory (QFT) is a conceptual framework which combines various strands of theoretical physics such as quantum mechanics and special relativity. It is also the basis for the construction of models which simulate the workings of subatomic particles, with the interaction of these particles visually represented by the computational tool known as [Feynman diagrams](#).

The nature of QFT calculations necessary to interpret the quantities of experimental data from initiatives such as the Large Hadron Collider (LHC) is such that each level of accuracy subsequently leads to yet more complicated and larger calculations. As this progression rests on the availability of new mathematical approaches, it presents ever-greater challenges for computation which can manipulate formulas that can be up to many bytes in size.

Reflecting on current computational tools Dr Jos Vermaseren HEPGAME (Solving High Energy Physics Equations using Monte Carlo Gaming Techniques) researcher adds, “To get the maximum benefit from findings such as those from the LHC requires extreme accuracy. Current calculations were completely unthinkable in the mid-70s when I was a graduate student. Nowadays we have 1 million times the CPU power – never mind storage capacity – and can run programs for days, weeks or even months, rather than seconds.”

One method that the project adopted to expand the range of calculations available was the [Monte Carlo Tree Search \(MCTS\)](#)  borrowed from game theory. MCTS’s ability to automatically compact mathematical expressions, which have to be repeatedly evaluated numerically, has resulted in it becoming part of the computer algebra system known as Form.

As Dr Vermaseren further explains, “Imagine a game of chess with its range of possible moves. Each move leads to reaction moves, creating a giant tree of possible games. MCTS allows us to assess the range of possible pathways against their outcomes, to find the optimum direction to take for the desired result.”

HEPGAME also used the Forcer programme to solve the [Integration By Parts \(IBP\)](#)  identities for a category of Feynman (four-loop massless propagator) diagrams, thereby making them calculable. Specifically, it was able to compute moments of splitting functions and structure functions in [‘Deep Inelastic Scattering’](#) . This approach is used to determine the quark and gluon contents and behaviour of protons more accurately. Almost all precision calculations for the LHC rely on these results.

Additionally, HEPGAME succeeded in finding a way to extract divergent parts from individual integrals occurring in Feynman diagrams. For this, the Rstar programme was used in conjunction with Forcer to compute divergences of up-to-5-loop propagator diagrams.

Will neural nets be game-changers?

The team is continuing to work on this two-pronged approach of simplifying expressions, while solving the IBP relations, for calculations too complicated to be currently handled.

Projecting ahead, the development of neural nets might offer the necessary step-change towards interpreting increasingly precise data. As Dr Vermaseren explains, “The simplification of expressions can be very much improved by training neural nets. It should also be possible to train neural networks to themselves devise methods to solve the IBP relations for reactions that are currently too complicated for our tools.”

Towards this end, Dr Vermaseren is currently working with AI systems which could potentially do just that. These developments will also need more powerful computer algebra, therefore two ex-members of the team are working on the creation of a successor to Form.

Keywords

HEPGAME], computation, calculation, high-energy physics, quantum physics, AI, neural networks, Large Hadron Collider, mathematics, game theory, formula

Project Information

HEPGAME

Grant agreement ID: 320651

Closed project

Start date

1 July 2013

End date

30 June 2018

Funded under

Specific programme: "Ideas" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Total cost

€ 1 739 000,00

EU contribution

€ 1 739 000,00

Coordinated by

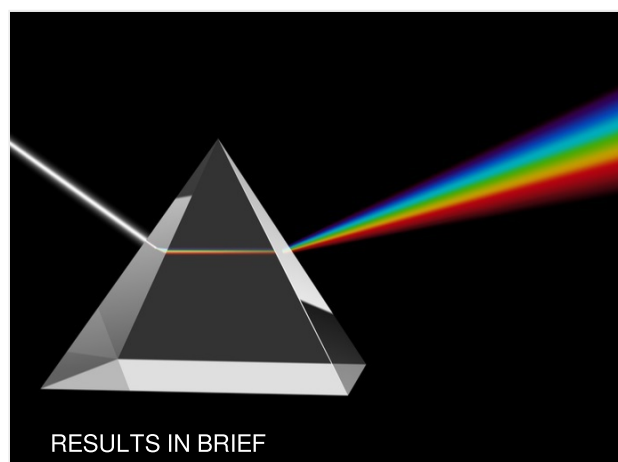
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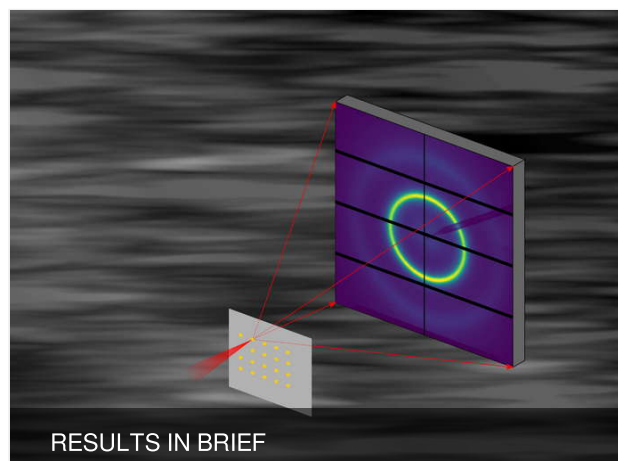
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4 August 2020



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26 January 2024



RESULTS IN BRIEF

Project breaks new grounds in AI to create 'DNA of language'



25 August 2023

Last update: 21 November 2018

Permalink: <https://cordis.europa.eu/article/id/241032-game-theory-and-ai-offer-more-precise-calculations-for-quantum-physics>

European Union, 2024

BotsAndUs - First Assistant Robot for Retail, Hospitality, Airports and Real Estate Buildings

Results in Brief

Autonomous robots aim to enhance customer service

The robots are coming! But no need to panic, these robots aim only to improve the customer experience. That's because one technology company is using artificial intelligence, autonomous systems and robotics to design a fleet of robots that businesses can use to independently interact with – and help – their customers.



DIGITAL ECONOMY



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Whether it be retail, hospitality, transportation or real estate, all businesses are, to paraphrase Simon and Garfunkel, 'just trying to keep their customers satisfied'.

Ask any of these businesses and they will be quick to tell you that the key to customer satisfaction is great customer service. Yet if good customer service is so important, why is so much of it still so bad?

"Billions of euro are lost every year across various industries due to bad customer service," says Andrei Danescu, CEO and co-founder of [BotsAndUs](#) , a London-based technology company specialising in robotics and artificial intelligence.

With the support of the EU-funded BOTSANDUS (First Assistant Robot for Retail,

Hospitality, Airports and Real Estate Buildings) project, the company is working to leverage the power of technology to put an end to bad service. According to Danescu, the project aims to build an innovative solution that can help businesses avoid losing sales and alienating customers due to inadequate customer service.

“Our mission is to create a fleet of autonomous customer service robots that work for and alongside people,” he explains. “To do this, we are building robots that not only are truly helpful and easy-to-use, but also use customer-centred human-robot-interaction algorithms.”

BotsAndUs’ portfolio currently consists of two fully autonomous service robots called [Bo](#) and [Mim](#). While Bo can independently interact with customers in multiple languages, deliver real-time insights, and even show customers where to find a product, Mim provides bricks-and-mortar retailers with real-time access to accurate and relevant store data.

Pushing the boundaries of human-robot interaction

With the aim of preparing the company’s robots for commercialisation, this project conducted multiple proof of concept trials with some of Europe’s biggest brands, including British Airways, [MediaMarktSaturn](#), Heathrow Airport and dnata.

“Not only did these real-environment trials validate the robustness of our solutions, they also confirmed our assumptions on how humans and robots interact,” remarks Adrian Negoita, CTO and co-founder of BotsAndUs. “This allows us to push the boundaries of human-robot interaction and develop state-of-the-art algorithms for optimal communications in noisy environments and with groups of end users.”

Another important outcome of the project was the development of autonomous navigation technology designed specifically for dynamic public spaces, such as airports. “Using distributed artificial intelligence systems, we created a fleet intelligence infrastructure that allows our robots to both learn from each other and collaborate on tasks,” adds Negoita.

Negoita notes that when the COVID-19 pandemic wreaked havoc on the retail and travel industries, many companies turned to technology and, in particular, robotics. “We used this opportunity to focus our technology on helping create and enforce social distancing policies without compromising customer service and satisfaction,” he says. “We spent significant time and resources building the bridge between the online and offline realms so businesses could offer their customers a seamless and safe experience.”

Redefining customer service

The BOTSANDUS project has the distinction of being the first to deploy robots in real, public environments – a breakthrough that has garnered notable attention in the global press, including coverage by CNBC, CNN, ‘The Wall Street Journal’ and ‘Forbes’ [\[4\]](#).

“We will continue to chase our vision of bringing easy-to-use and helpful robotics that can liberate us from dull, repetitive and even dangerous tasks, allowing humans to focus their time on the things that truly matter,” concludes Danescu. “As we expand into new markets, we will continue to redefine customer service, ensuring that companies of all sizes and types can keep their customers satisfied.”

Keywords

BOTSANDUS, autonomous, robots, customer service, artificial intelligence, robotics, hospitality, transportation, real estate

Project Information

BOTSANDUS

Grant agreement ID: 849938



DOI

10.3030/849938 

Closed project

EC signature date

20 February 2019

Start date

1 March 2019

End date

30 June 2021

Funded under

INDUSTRIAL LEADERSHIP - Innovation In SMEs

PRIORITY 'Societal challenges

INDUSTRIAL LEADERSHIP - Leadership in
enabling and industrial technologies

Total cost

€ 2 649 687,50

EU contribution

€ 1 854 781,25

Coordinated by

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 United Kingdom

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9 June 2023



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30 July 2021

Last update: 26 February 2021

Permalink: <https://cordis.europa.eu/article/id/429190-autonomous-robots-aim-to-enhance-customer-service>

European Union, 2024

Automatic optimisation of the injection moulding process

Results in Brief

Artificially intelligent injection moulding

Injection moulding, a forming process for thermoplastic polymers, consists of injecting liquid plastic into a heated mould to produce a shape. An automatic optimisation system for the above process, which will be exploited by the plastics industry, is close to completion.



The European plastics industry has lost considerable ground the last few years due to severe competition with the Far East, where labour is much cheaper. Use of and rapid adaptation to new technologies is essential for protecting the one million jobs in this industrial sector.

Injection moulding is the main, if not the only way of forming plastics can greatly benefit from a new automatic optimisation scheme. A robot moves the moulded products to three different stations where gloss, dimensions and weight are measured. The data obtained are fed into three artificial intelligence modules and compared with information regarding the process that is already stored. A control module, depending on the outcome of the comparison, is able to alter the working parameters of the injection-moulding machine.

A gloss meter working in scanning mode, automatic in-line measurement of plastic components dimensions and a design procedure for manufacturing instrumented injection moulding nozzles, are few of the innovations provided by researchers.

Industrial trials were successful, but not extensive enough to allow immediate commercialisation. The technology though looks promising and the aim of reducing the optimisation time for new products by 50-70% and increase production efficiency by 20-30% is well within its capabilities.

Project Information

OPTIM

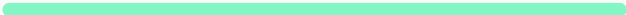
Grant agreement ID: BRPR950123

Start date

1 February 1996

End date

31 October 1999



Funded under

Specific research and technological development programme in the field of industrial and materials technologies, 1994-1998

Total cost

€ 0,00

EU contribution

€ 0,00

Coordinated by

NPL MANAGEMENT LTD.

 United Kingdom

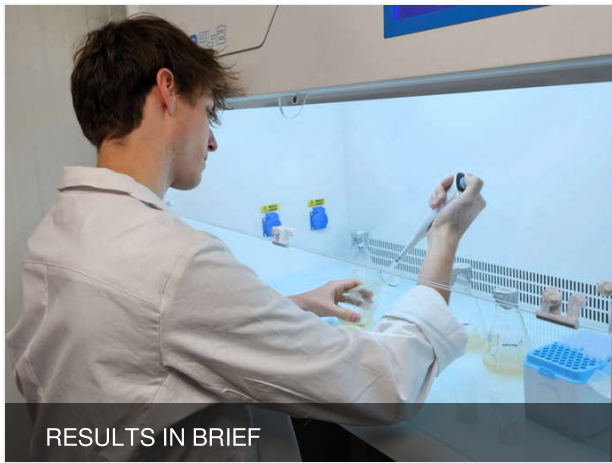
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5 February 2024



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5 February 2024



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28 April 2023

Last update: 18 September 2005

Permalink: <https://cordis.europa.eu/article/id/80137-artificially-intelligent-injection-moulding>

European Union, 2024

KACHING - THE FUTURE OF RETAIL IN THE PALM OF YOUR HANDS

Results in Brief

Digitising brick-and-mortar retail stores

Retailers stand to benefit from a ground-breaking mobile Point of Sales solution developed by EU project Kaching.



DIGITAL ECONOMY



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Retail is becoming increasingly digital, and traditional brick-and-mortar stores that fail to adapt risk losing market share – or worse. That’s why some of the leading names in retail are looking for innovative new solutions that combine the convenience of online shopping with the customer focus of the in-store experience.

To help retailers strike this balance, www.kachingretail.com/ (Kaching Retail), a Sweden-based technology company, has developed a flexible line-up of digital applications for every type of store.

“The retail ecosystem must incorporate solutions that meet 21st century customer expectations,” says Nick Toumpelis, Product Lead at Kaching Retail and Kaching project coordinator. “With the support of EU funding, we set out to discover what the particular needs of today’s retailers are and, based on this, create the right product.”

The outcome of this effort is a ground-breaking mobile Point of Sales (mPOS) solution.

Back to the drawing board

Initially, the mPOS solution was designed for retailers coming from the large enterprise segment of the market, such as IKEA and MediaMarkt. However, Kaching quickly discovered that this targeted segment posed some significant challenges. For example, large enterprises require a POS solution to be fully integrated into a company's existing – and often complex – product catalogues and accounting, customer relationship management, and [enterprise resource planning](#)  systems.

“Although retailers understand the need to improve their customer experience – and want to have systems to facilitate these improvements, they are often held back by concerns over business disruptions, [sunk costs](#) , and compatibility with other critical systems,” explains Toumpelis.

As a result, the company decided to go back to the drawing board. The result is an mPOS that is faster to scale, easier to manage and more robust than anything currently on the market – and thus ideal for both large enterprises and small businesses alike.

“In addition to being a perfect match for this niche market, our solution is complete, efficient and a delight to use – both for the retail end customer and for store employees,” says Toumpelis. “By emphasising mobility and leveraging the power of artificial intelligence and [data mining](#) , the Kaching mPOS enables a better store experience.”

By Europe, for Europe

Although POS systems are quite common, the Kaching solution stands out in that it was designed without any preconceived notions about what an mPOS solution should look like. “As we talked with retailers, we discovered a lot of unmet needs,” adds Toumpelis. “We designed Kaching to address these needs, and the customer and employee satisfaction metrics that we monitor are a testament to that.”

The Kaching mPOS is also unique in that it is a European solution that empowers European retailers to compete against the likes of such online retail giants as Amazon, Walmart and Alibaba.

Kaching is now using the insight it gained during this project to develop an mPOS version specifically for small retailers.

Keywords

Kaching, Kaching Retail, mobile Point of Sales, mPOS, Point of Sales, POS, retail, brick-and-mortar store, online shopping, Ikea, MediaMarkt, artificial intelligence, AI, Amazon, Walmart, Alibaba

Project Information

Kaching

Grant agreement ID: 854725



DOI
[10.3030/854725](https://doi.org/10.3030/854725)

Closed project

EC signature date
28 January 2019

Start date End date
1 February 2019 31 July 2019

Funded under
INDUSTRIAL LEADERSHIP - Innovation In SMEs
PRIORITY 'Societal challenges
INDUSTRIAL LEADERSHIP - Leadership in
enabling and industrial technologies

Total cost
€ 71 429,00

EU contribution
€ 50 000,00

Coordinated by
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Neural pathways inspire computing breakthroughs



9 June 2023

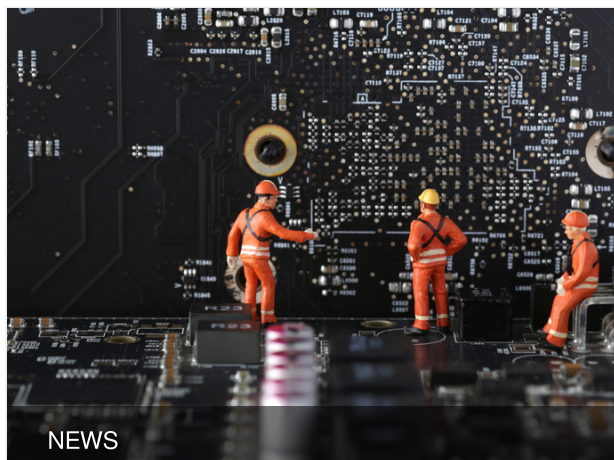


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30 July 2021

Last update: 3 January 2020

Permalink: <https://cordis.europa.eu/article/id/413185-digitising-brick-and-mortar-retail-stores>

European Union, 2024

Labelling of engineered nanomaterials for nanosafety tracing

Results in Brief

A new way of tracing engineered nanomaterials

An innovative labelling technique could help researchers better understand the potential safety risks of engineered nanomaterials.



CLIMATE CHANGE
AND ENVIRONMENT



INDUSTRIAL
TECHNOLOGIES



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Due to their unique size, engineered nanomaterials (ENMs), or [nanomaterials](#)  designed and produced by humans, offer a range of advantages. For example, in healthcare, they have the potential to help deliver medication to otherwise inaccessible areas of the body. In agriculture, they can help improve the efficient use of agrochemicals, while industry uses them as additives to enhance the strength and life of chemicals.

“Because ENMs are difficult to detect in complex biological tissues and environments, we have little understanding about the safety risks they could pose,” says Eugenia Valsami-Jones, coordinator of the EU-funded NanoLabels project which was supported the Marie Skłodowska-Curie Actions programme.

“Until we build enough confidence about where these materials go and what they do, especially after their intended use, the use of ENMs will remain limited.”

One way researchers make ENMs more detectable is by adding a tracer, or label.

Unfortunately, doing so can modify or change the ENMs and thus alter their environmental and biological behaviour. For this reason, tracers have been of limited use in terms of understanding nanosafety.

To improve their usefulness, the NanoLabels project has developed innovative labelling techniques that could allow ENMs to be traced in their natural environment.

Creating a labelling strategy

Researchers at the [University of Birmingham](#)  have spent the last decade working on using [stable isotopes](#)  to label ENMs – an approach that has proved to be both efficient and highly sensitive at detecting ENMs in environmental-relevant concentrations.

“The NanoLabels project builds on this work, creating a labelling strategy that can be adopted by industry to facilitate, for example, nanosafety assessments before ENMs enter the market,” explains Valsami-Jones, a professor of environmental nanoscience at the University of Birmingham.

By exposing rice plants to different labelled [nanoparticles](#) , researchers were able to track the movement of nanoparticles within the plant and discover where they go and what they do. “For the first time, we used stable isotope labelling to track the translocation of a nanomaterial within plants,” notes Valsami-Jones.

According to Valsami-Jones, the project demonstrated that physicochemical properties, such as size and morphology of the nanoparticles, are no different from the nanoparticles without isotope labelling. “This suggests that the labelling was a success and could be used with confidence in other tracing studies,” she adds.

A successful methodology

The NanoLabels methodology succeeded at detecting the uptake of ENMs in the environment, even at a very low concentration. “The labelling methodology we developed in this project, which has been subsequently published in [‘Nature Protocols’](#) , has put our ‘stamp’ on this developing field of research,” says Valsami-Jones.

“It will also play a big part in educating the next generation of nanoscientists in using isotope labelling techniques.”

Another important outcome of the project is scalability. “We expect that the scaling-up of the synthesis of stable isotope labelled ENMs could be tested, modified and standardised. It has the potential to be used in such industrial applications as the

Project researchers are currently developing labelling for carbon-based nanomaterials, such as carbon nanotube, graphene and microplastics. “With carbon being the most common element in the environment, the tracing of carbon-based nanomaterials is extremely difficult – so watch this space,” concludes Valsami-Jones.

NanoLabels, engineered nanomaterials, nanomaterials, nanoscience, nanosafety, stable isotopes, nanoparticles

NanoLabels



[10.3030/750455](#)

17 March 2017

1 February 2018

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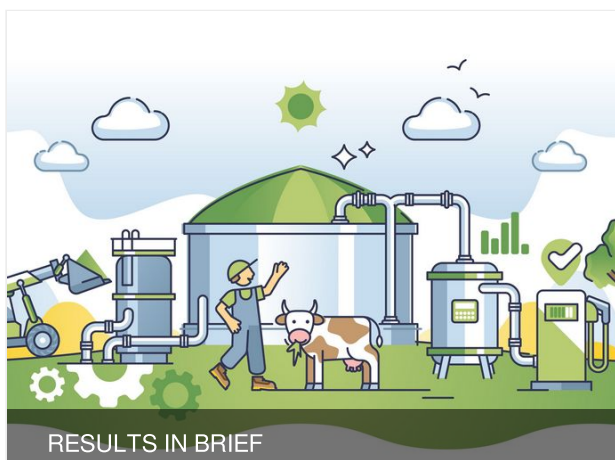


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28 April 2023



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27 September 2023

Last update: 27 July 2020

Permalink: <https://cordis.europa.eu/article/id/421612-a-new-way-of-tracing-engineered-nanomaterials>

European Union, 2024

Holographic Vision for Immersive Tele-Robotic Operation

Results in Brief

Holographic vision enables immersive telerobotic operations

Combining holographic headsets with video feed from multiple camera angles could enable teleoperators to carry out dangerous or difficult operations remotely, in a much more immersive manner.



DIGITAL ECONOMY



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Performing remote, delicate manoeuvres with teleguided robot arms is a critical operation required in numerous sectors, from repairing oil rigs underwater to nuclear plant reactor manoeuvres and space exploration.

The more accurate and easier the operation is to execute, the greater the likelihood of a successful outcome. New advances in this field could also open up potential new applications in other sectors.

Better remote situational awareness

To this end, the EU-funded [HoviTron](#)  project sought to develop a holographic headset, together with a multi-camera video feed, which enables a teleoperator to feel fully immersed in a situation while operating at distance.

“We wanted to provide the teleoperator with the ability to visualise the scene from

any viewpoint,” explains project coordinator Gauthier Lafruit from the [Université Libre de Bruxelles \(ULB\)](#) in Belgium. “Our idea was to use video processing, instead of having to reposition a camera with a pan-tilt robot arm mechanism.”

To achieve this, a number of fixed cameras are set up around the scene. Videos recorded in real time are then blended into a virtual viewpoint, corresponding to the teleoperator’s head position.

“This means that abrupt movements of the teleoperator’s head instantly create the corresponding images in the stereoscopic head-mounted display they are wearing,” adds Lafruit. “There is no mechanical latency, which can cause [cybersickness](#).”

Additionally, each eye captures a holographic light field wavefront. This ensures that the teleoperator’s eyes can focus on the object of interest at will, irrespective of whether the object is positioned in the foreground or background. In doing so, this perfectly mimics natural human vision.

“Together, the video feed and holographic vision ensure that the telerobotic operator feels fully naturally immersed in the scene, while being far away from a situation that might be hazardous or difficult to access,” says Lafruit.

Accurate, instantaneous vision

The project team applied synthetic, video game-like content along with real images to test the technology’s viability under various working conditions. Users confirmed that they felt less visual fatigue (and ultimately less physical fatigue) when wearing the holographic headset, and that their depth perception was enhanced.

The hope is that these successful trials could open up a number of interesting applications. “For example, the technology could be used on future moon missions,” notes Lafruit. “Robots on the moon could place cameras around a scene, enabling astronauts in orbit to really see through the eyes of a moving robot.”

The traditional technique of putting cameras in the robot’s head means that any rapid movement by the headset-wearing astronaut creates a time lag between images, causing cybersickness. HoviTron’s ability to instantaneously calculate the correct images to project in the astronaut’s eyes does remove this obstacle.

New navigation application possibilities

Lafruit sees the technology as having potential applications in any situation where ‘free navigation’ is required. A diving robot for example could repair a deep-sea pipeline, while the teleoperator remains safely on board a ship or platform.

Such specialised applications however will require more investment, in order to further develop the technology. The project team is currently in touch with a company specialised in depth-sensing devices.

“Source code will soon be provided under the [Apache 2.0](#)  licence on our website,” adds Lafruit. “We can promote our technology by letting people try it out themselves in a free navigation scenario using simple pre-recorded examples, without the robot arm, high-quality depth-sensing and/or camera devices and holographic virtual reality goggles, of course.”

Keywords

HoviTron, holographic, video, teleoperators, robot, space, telerobotic, astronauts

Project Information

HoviTron

Grant agreement ID: 951989



DOI

[10.3030/951989](#) 

Closed project

EC signature date

4 May 2020

Start date

1 June 2020

End date

30 November 2022

Funded under

INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

Total cost

€ 1 652 285,00

EU contribution

€ 1 537 385,00

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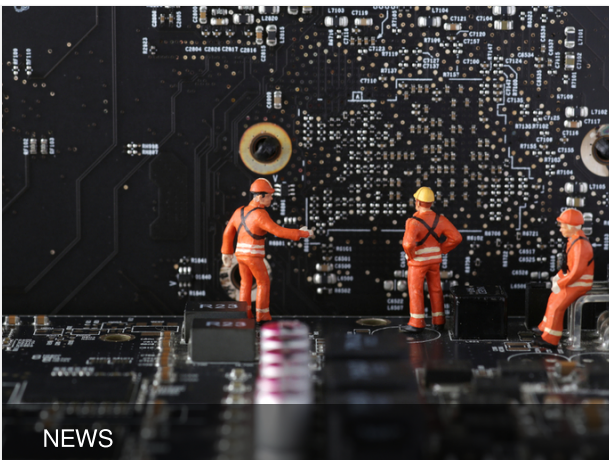


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30 July 2021

Last update: 11 April 2023

Permalink: <https://cordis.europa.eu/article/id/443195-holographic-vision-enables-immersive-telerobotic-operations>

European Union, 2024

REconciling sScience, Innovation and Precaution through the Engagement of Stakeholders

Results in Brief

New guidance to help drive responsible innovation

The development of new technologies presents opportunities for society but it can also carry risks to humans or the environment. EU-funded researchers have sought to aid policymakers in carefully assessing the benefits and potentially dangerous effects of innovative technologies.



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the precautionary principle.

Precautionary principle

Pioneering science and innovation has brought societies huge benefits. Cutting-edge breakthroughs have helped to address chronic diseases, achieve more sustainable agriculture and bring a range of new products to market.

There is however always a degree of uncertainty surrounding new and emerging technologies. When faced with possible concerns over impacts on the environment or health, policymakers exercise what is called

Enshrined in the [European treaties](#), the principle aims to ensure a high level of environmental and health protection through preventative decision-making, in the case of risk.

“The precautionary principle allows decision makers to act when faced with unacceptable risks, scientific uncertainty and public concerns,” explains [RECIPES](#) project co-coordinator Kristel De Smedt from [Maastricht University](#) in the Netherlands. “In other words, when in doubt, be cautious.”

One difficulty is that there is no clear consensus over how the precautionary principle should be implemented in practice. While the precautionary principle encourages early action to minimise risk, critics believe that over-deployment of the principle can hamper technological innovation.

Responsible innovation

The RECIPES project links the precautionary principle with the notion of ‘responsible innovation’ and helps decision makers exercise the precautionary principle in a manner that both protects citizens and encourages scientific endeavour.

To begin, the project assessed the implementation of the precautionary principle in Europe since 2000.

This helped the team to come up with a conceptual framework that aligns the precautionary principle with what it calls responsible innovation. “We took the view that innovation needs to be ‘for’ something,” adds De Smedt. “It should be used to help achieve sustainable development, for example.”

The team then applied this framework to a series of case studies. These case studies touched on issues such as the debate surrounding genetically modified organisms, endocrine disrupting chemicals and the use of artificial intelligence in healthcare.

The case studies formed the basis of scenarios for the future of the precautionary principle and innovation. An important outcome of discussions with various stakeholders was that precaution is not fundamentally opposed to innovation.

Guidance for policymakers

One of the key messages of the RECIPES project is that the precautionary principle works best when it is used as both a safeguard and a compass.

As a legal principle and safeguard, it can justify early policy or regulatory action to manage uncertain risks, ensuring that EU citizens are protected. And as a compass

or policy principle guiding innovation, it can trigger debates within research about potential impacts, leading to necessary adjustments in development towards sustainable choices. This is what the project means by responsible innovation.

The main deliverable of the project has been the development of a [guidance document](#) , for policymakers. This was based on case study work carried out during the project, as well as workshops with policymakers and stakeholders, to take account of their views.

The document provides advice on dealing with uncertain risks, guided by this principle of responsible innovation. Target groups include not just policymakers but also government agencies, policy support organisations and bodies concerned with risk regulation.

The RECIPES team also developed sector-specific [recommendations](#) , for the chemicals and [gene technology](#) sectors, to explain what the guidance would mean for these two sectors and how responsible innovation might be implemented. This will help to increase understanding of the concept within and drive cutting-edge research.

Keywords

RECIPES, technologies, precautionary principle, innovation, health, agriculture, diseases

Project Information

RECIPES

Grant agreement ID: 824665



DOI

[10.3030/824665](https://doi.org/10.3030/824665)

Closed project

EC signature date

23 November 2018

Start date

1 January 2019

End date

30 June 2022

Funded under

Take due and proportional precautions in research and innovation activities by anticipating and assessing potential environmental, health and safety impacts

Total cost

€ 1 999 831,25

EU contribution

€ 1 999 831,25

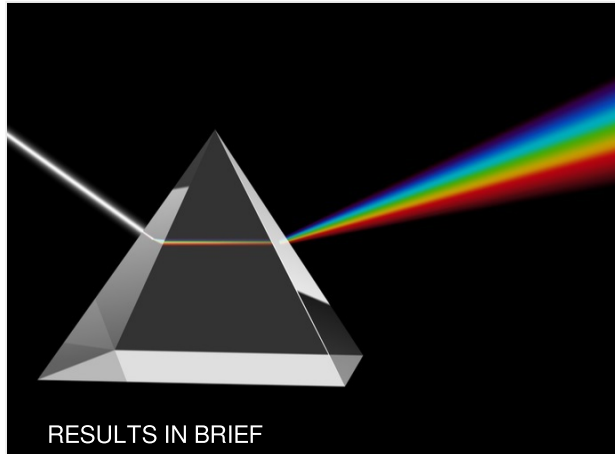
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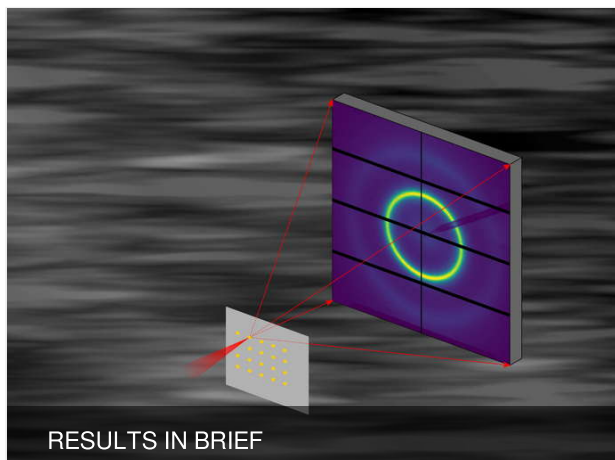
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25 August 2023

Last update: 10 November 2022

Permalink: <https://cordis.europa.eu/article/id/442493-new-guidance-to-help-drive-responsible-innovation>

European Union, 2024

European Core Technologies for future connectivity systems and components

Results in Brief

Ensuring European readiness for personal robotics era

The market for personal robotics is expected to boom over the next few years. An EU-funded roadmap has identified critical steps Europe must take, to remain at the cutting edge of this emerging tech revolution.



DIGITAL ECONOMY



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The exponential growth of data rates and continual broadening of applications has led to a constant evolution in [cellular networks](#). While 1G and 2G technology standards were focused mainly on voice telephony, 3G and 4G incorporated the emergence of [broadband](#).

“My feeling is that we are again at the beginning of two generations of innovation,” remarks [COREnect](#), project coordinator Gerhard Fettweis from [TU Dresden](#) in Germany.

“In addition to higher data rates, we are going to see the emergence of more robotic applications, first for businesses and then for consumers.”

Radar sensing technology

The EU-funded COREnect project was launched to establish a technology roadmap, to help European industry anticipate and take full advantage of the opportunities presented by 5G and 6G.

To begin, the project brought together over 100 experts from the microelectronics and telecommunications communities. There was broad consensus that 5G – and especially 6G – will see enormous growth in the [personal robotics](#) market.

These robots will be designed to help with a range of household tasks, assist with shopping and provide a range of entertainment services.

Europe's strengths and weaknesses in microelectronics for telecommunications were discussed, and key challenges ahead pinpointed.

“We identified two key issues affecting personal robotics – latency and reliability,” says Fettweis. “You don't want to lose connectivity, and thus lose control of your robot.”

In addition, Fettweis and his team identified radar as a key enabling technology for future 6G chip platforms. Radar helps robots navigate and perform their services. “Cameras everywhere aren't ideal because of privacy concerns,” he adds. “So, we'll need radar sensing technology and to understand how to incorporate it into chip platforms.”

Robotic operational system

This was one of the key challenges that COREnect focused on. The project team realised that a world filled with robots chirping away like bats, building up their own personal echo images, would create a great deal of interference and impact on latency and reliability.

“If, however, personal robotic radar systems obeyed a master, and only started chirping when told to, then the situation would be different,” explains Fettweis.

The central recommendation from the COREnect project has therefore been this need for Europe to build a coordinated communication system, with bespoke platform chips, designed for both communication and sensing.

“This is the key outcome of COREnect,” notes Fettweis. “It is clear that Europe should design the whole operational system for next-generation personal robotics, and not just import electronic chips from abroad and add casings, as it has done in the past.”

European platform chips

For Fettweis, the project has been a useful and timely wake-up call for industry. Europe has a huge opportunity to take advantage of the personal robotics revolution that 5G and 6G will bring, so long as industry acts now and begins to build a unique chip platform.

There have been encouraging signs. The success of the COREnect consortium has resulted in the launch of a follow-on EU-funded project, called COREnext.

Due to begin in January, this will begin the work of building the infrastructure needed for developing a European platform chip to serve upcoming needs and challenges.

“Personal robotics is going to be a huge market,” says Fettweis. “Europe is really well placed, because it has a great reputation for maintenance and quality. What this project has done is underline the importance of designing and holding the IP of the chips.”

Keywords

COREnect, robotics, cellular, 5G, radar, telephony, data, microelectronics

Project Information

COREnect

Grant agreement ID: 956830



DOI

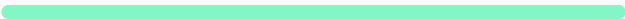
[10.3030/956830](https://doi.org/10.3030/956830)

Closed project

EC signature date
18 June 2020

Start date
1 July 2020

End date
30 June 2022



Funded under
INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

Total cost
€ 999 562,50

EU contribution
€ 999 562,50

Coordinated by
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9 June 2023

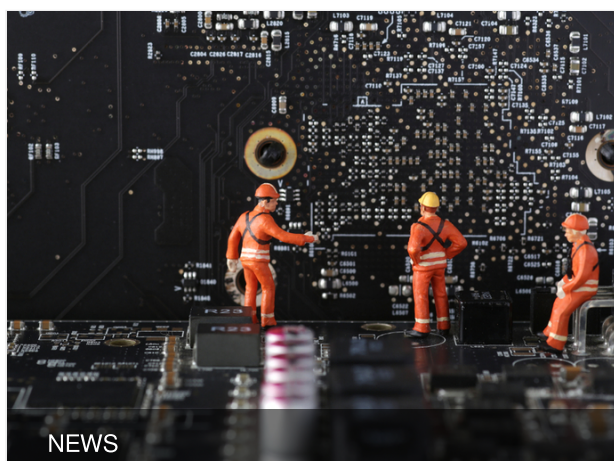


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30 July 2021

Last update: 10 November 2022

Permalink: <https://cordis.europa.eu/article/id/442483-ensuring-european-readiness-for-personal-robotics-era>

