

list
cea tech



HIGHLIGHTS 2018



université
PARIS-SACLAY

CEA LIST is a government research organization based in Saclay, France. An institute of the French Alternative Energies and Atomic Energy Commission (CEA), LIST is home to international-caliber scientists and technology experts united in their commitment to innovating breakthrough digital solutions and transferring them to industry through R&D partnerships.

Each year, LIST breaks new ground in the factory of the future, artificial intelligence, cyberphysical systems, e-healthcare, and other technologies crucial to the economy and society. These innovations help make the institute's more than 200 partners—companies of all sizes and from all industries—more competitive.

LIST is a member of the Carnot Network: Institut Carnot Technologies Numériques@UPSaclay (TN@UPSaclay).



www-list.cea.fr/en

03

Director's foreword:
Jean-Noël Patillon

04

LIST, fast-tracking a more
digital future

05

The Carnot Network,
recognition of excellence

06

Partnerships, the fuel
of innovation

08

The events
that made 2018

10 > 19

4 programs that are
reinventing innovation

20

Startups,
tech-transfer facilitators

22

3 foundational projects,
an international strategy

“The diverse and rapidly expanding range of topics our researchers investigate makes our ecosystem unique.

2018 was a year of validation for LIST. First, validation of the quality of our research:

France's higher education and research evaluation board (HCERES) gave us excellent marks for our technology research over the past five years. Second, validation of our positioning at the interface between the suppliers of technologies and the industrial companies that use those technologies as evidenced by an increase in the number of partnerships established to speed up digital innovation in France. This year, the trend is increasingly toward housing joint R&D programs at our facilities. This is the case for projects with shorter lifecycles like those carried out at the Siemens Digital Experience Center, which is dedicated to the development of manufacturing technologies, as well as for longer-term initiatives, such as the Artificial Intelligence component of our partnership with Total.

Artificial Intelligence is at the center of a number of major issues shaping our society. On March 29, 2018, French President Emmanuel Macron announced his Artificial Intelligence for Humanity strategy with the goal of making France an international leader in AI. LIST is gaining traction in AI for industry, an area that places specific demands—for precision, reliability, and security—on AI technologies. CEA LIST is also a member of DigiHall, which was certified by the French government as a center for expertise in AI for robotics. The certification, obtained thanks to the partnerships and programs run by DigiHall's members, bodes well for DigiHall's candidacy for AI Digital Innovation Hub.



JEAN-NOËL PATILLON
Director, CEA LIST

The global digital manufacturing trend illustrated by the new Digital Europe program will further raise LIST's profile among France's SMBs. Our R&D services help position these companies to effectively respond to the needs of the major corporations that purchase their technologies. Internationally, LIST stood out as an expert in cybersecurity, coordinating the SPARTA network of more than 50 European competency centers united in their quest to increase data security.

Our diversity—both in terms of our technology development projects and our scientific research programs—makes LIST particularly attractive to researchers. LIST scientists are given unique opportunities to take part in simulating projects from beginning to end, effectively taking new concepts

from idea to reality. We take a holistic approach to technology, drawing on the complementary know-how of the other CEA institutes, such as Leti, which specializes in micro and nanotechnology. An interdisciplinary culture and researchers knowledgeable about industrial R&D issues make LIST uniquely qualified to face the challenges just over the horizon, from a new generation of bio-inspired AI to collaborative robotic systems for factories. The innovations in the following pages are diverse, but all of them reflect LIST's commitment to digital transformation and the people making it happen.



LIST, fast-tracking a more digital future

**CEA LIST develops breakthrough digital technologies
and builds innovation-sustaining ecosystems to meet the needs
of industrial companies.**

Foster open innovation

As the systems and technology integration arm of the CEA, LIST is on the front lines of the digital transition. The institute maintains a laser-sharp focus on smart digital systems R&D. LIST's mission is to develop breakthrough innovations capable of bringing manufacturing into the future and to invent applications for Artificial Intelligence that safely support human endeavor.

Maintain a culture of excellence

LIST is a member of the Carnot Network (Institut Carnot TN@UPSaclay), a mark of recognition for the institute's international-caliber research. Our 850 research scientists and engineers are at the state of the art in their respective fields, and their work is regularly published in top-tier international journals. They possess a unique ability to detect emerging digital innovation needs and to patent breakthrough technologies with applications in a broad range of industries like manu-facturing, mobility, energy, healthcare, and cybersecurity.



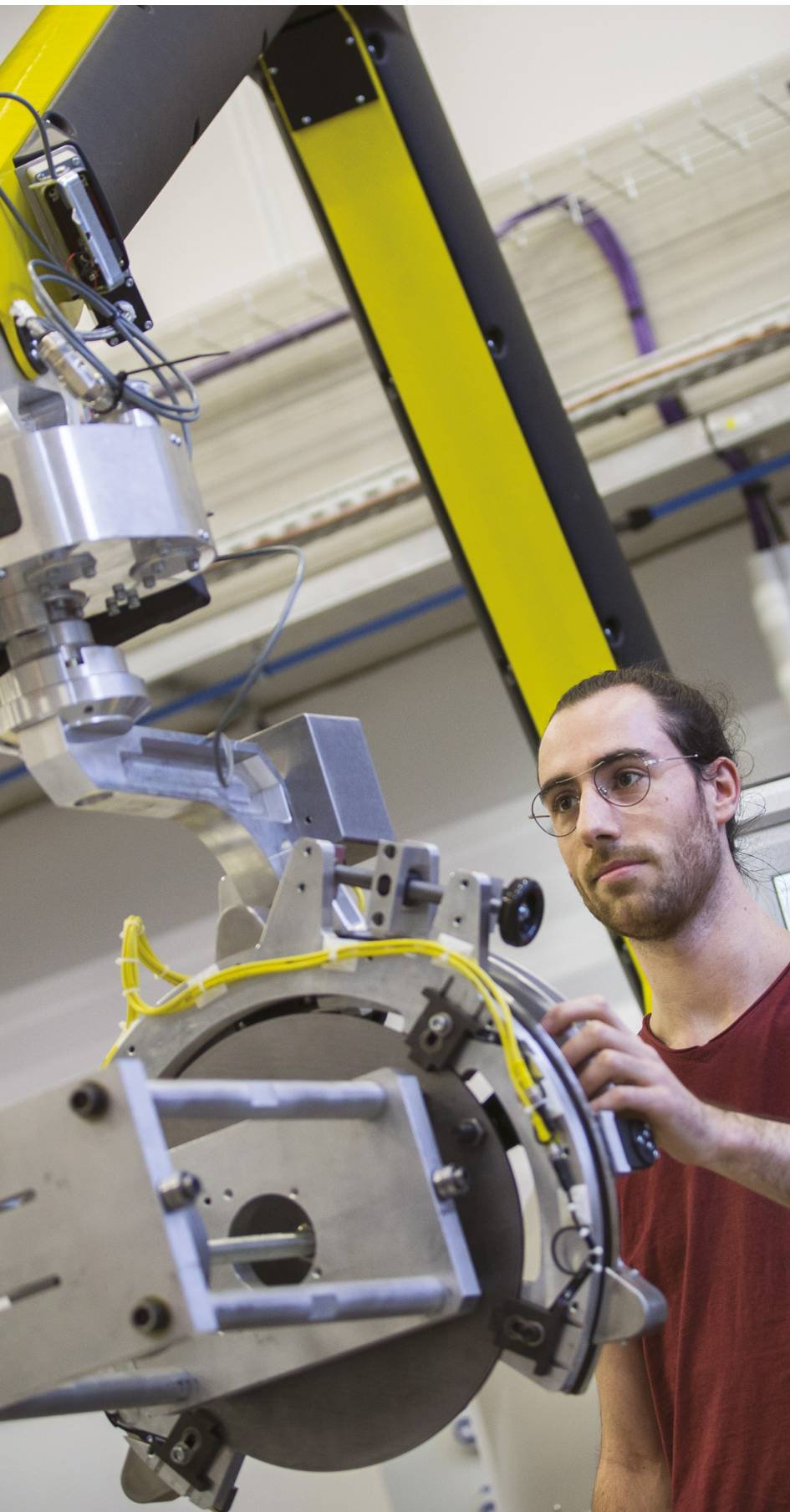
“LIST removes the technological hurdles to developing breakthrough solutions, enhancing existing products, and improving industrial processes.

Create value

Our R&D services are designed for companies of all sizes, from SMBs to multinational corporations. The aim of all of our partnerships is to work cooperatively to transfer high-added-value technologies to our partners. Each year, we work with more than 200 partners on programs that address major economic and societal challenges.

Inspire innovation ecosystems

Our development philosophy takes the form of an open innovation ecosystem in which all partners are actively encouraged to interact, whether they are working together on basic scientific or other early-stage research or later-stage projects. At the national level, we are expanding our academic, collaborative, and industrial partnerships. At the international level, we are engaged in more than 200 high-level European projects and are strengthening our presence outside Europe—in the United States in particular—through far-reaching programs.



THE CARNOT NETWORK, RECOGNITION OF EXCELLENCE

LIST is one of 29 government research organizations to have earned the Carnot seal from the French Ministry of Higher Education, Research, and Innovation. Membership in the Carnot Network recognizes excellence in service to industrial companies and their economic competitiveness.

The Carnot Network was founded in 2006 to facilitate research partnerships between government research organizations and businesses and other socioeconomic stakeholders. The overriding objectives are to increase access to innovation, support expansion into new markets in France and overseas, and create jobs.

The Carnot Network selection process is rigorous, and once granted, membership must be renewed every four years. LIST has been granted membership in this network of excellence three times (2006, 2011, 2016). LIST is the Carnot Network's institute for digital technology:

Institut Carnot Technologies Numériques @ Université Paris-Saclay (TN@UPSaclay).





PARTNERSHIPS, the fuel of innovation

LIST develops and transfers technologies designed to add value to businesses of all sizes and from all industries.

Our strategy involves developing generic technology bricks that can be used to build custom solutions tailored to our partners' specific needs.

Our close relationships with systems integrators and technology suppliers (including startups spun off from LIST labs and projects) help us to determine which technologies to develop. In fact, we benefit from a unique insider perspective on industrial companies' needs, and the insights we gain from these relationships are invaluable when it comes to orienting our strategy roadmaps. In short, we strive to ensure that our programs respond effectively to companies' current and future digital innovation needs.

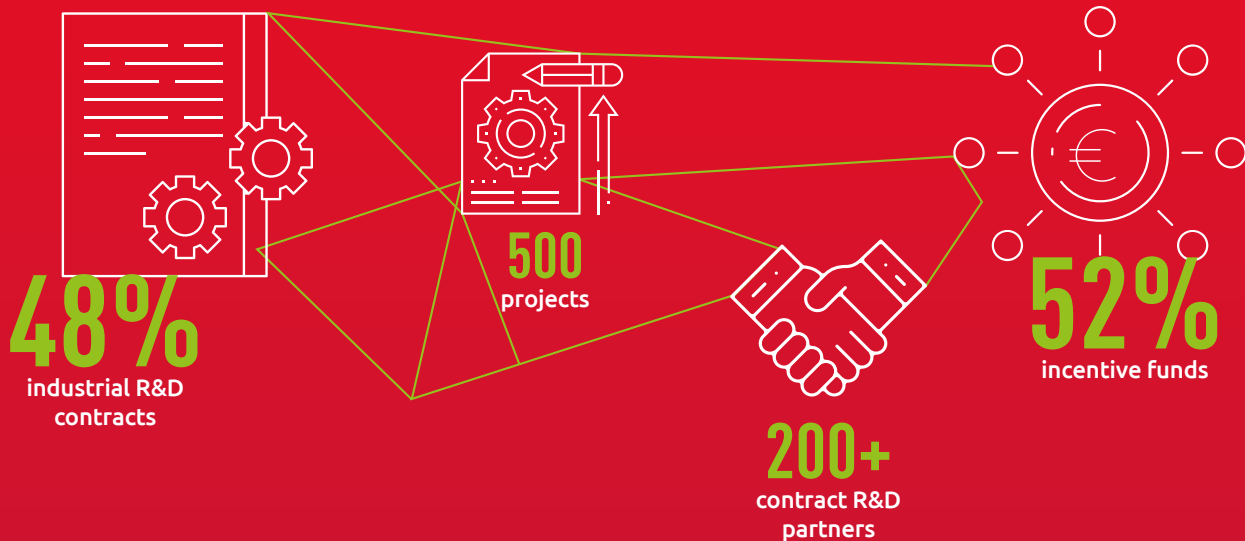
The generic technology bricks developed are then implemented for specific applications by our industrial R&D partners. These partners benefit from the experience of systems integrators to help make their end solutions as efficient as possible.

LIST STRENGTHS

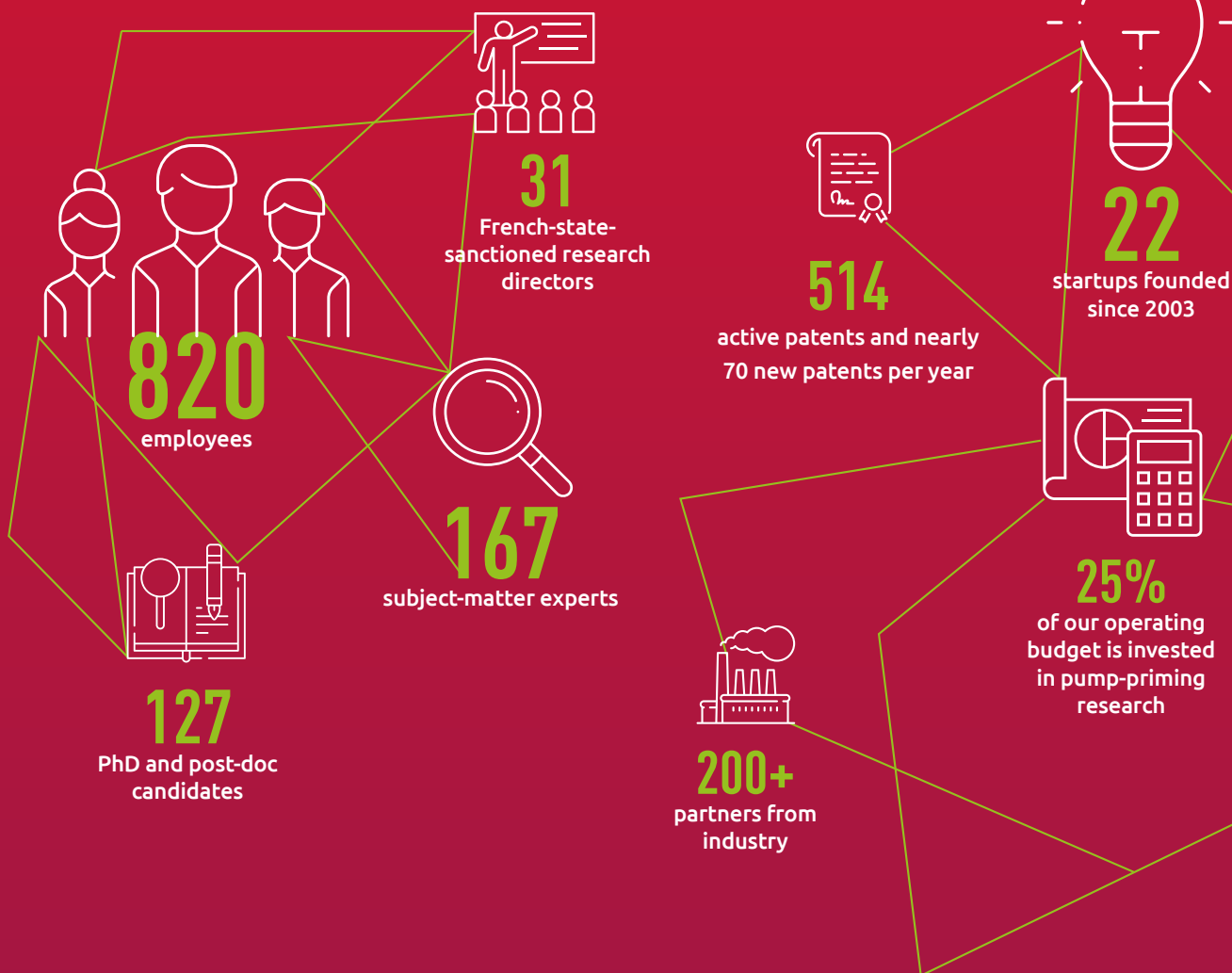
- A portfolio of patented generic technology bricks that can be used in a wide range of industries.
- An integrative approach that focuses on complete solutions that are coherent and optimized for our partner companies.
- 20 technology platforms with resources that include state-of-the art equipment and a wealth of knowledge in our four strategic programs: factory of the future, artificial intelligence, cyberphysical systems, and e-healthcare.



“Startups, whether they are LIST spinoffs or created by LIST partners, play a large and constantly growing role in our strategy.”



2018 KEY FIGURES



THE EVENTS THAT MADE

2018

Discover ten events that made 2018 and that brought our day-to-day lives a step further into the future.

FEBRUARY 19

Exegis speeds up transportation engineering

Egis and the CEA announced the release of Exegis, a requirements management tool for large public transportation and rail projects like the construction of a new subway line, for example. The tool is built on LIST's Papyrus and interfaces the habitual management tools in such a way as to provide a digital model of the project.



JANUARY 3

Artificial Intelligence lab assesses vehicle vibrations



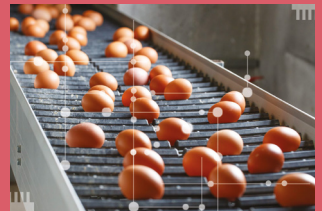
Carfit and LIST set up a joint lab to develop AI methods capable of identifying signs of mechanical failure from vehicle vibrations.

FEBRUARY 23

Blockchain boosts trust in the food industry

Startup Connecting Food partnered with LIST to introduce a blockchain-based real-time audit solution for manufactured food products. The purpose of this collaborative, transparent, and secure technology is to boost consumer trust.

Incentives encourage farmers—the first link in the food production chain—to enter accurate information into the system.



MARCH 15

National meeting for emerging SHM industry

A day-long national meeting on Structural Health Monitoring (SHM) was held at Digiteo Saclay. The principle behind SHM is to integrate sensors into structures, giving the structures “smart” capabilities. SHM is a multidisciplinary field that has repercussions across virtually all industries (aeronautics, civil engineering, energy, and more) and that will play a role in the current move toward digital processes and Artificial Intelligence. The meeting provided an opportunity to start building a SHM industry in France to transform the innovative solutions already developed into industrial success stories.



MARCH 27

The MindSphere Center “IoT factory”

Siemens and LIST celebrated the arrival of the MindSphere Center at Nano-INNOV on the Paris-Saclay campus. This innovation center will support the emergence of an ecosystem of partners that develop digital solutions for industry leveraging Siemens MindSphere IoT operating system.

APRIL 16

Artificial Intelligence makes patient care pathways more efficient

A company called Alicante joined forces with LIST AI researchers to enhance the capabilities of its Inquia platform, which leverages hospital data for applications in human and animal health.

The improved solution will enable practitioners to manage personalized patient care pathways, even for complicated cases.



JULY 12

National diabetes database

The M4P consortium introduced Diatabase, a national database of clinical diabetes data. The project is being funded under the government's economic stimulus package and aims to improve patient care and facilitate the study of a disease that affects 3.7 million people in France alone. LIST will bring expertise in the semantic analysis and utilization of unstructured data to the project.



MARCH 30

A pioneering bus advances smart parking

Paris public transportation authority RATP, LIST, and IVECO Bus joined forces to achieve Europe's first-ever demonstration of a self-parking bus in real-world conditions.

The experiment was part of the European Bus System of the Future 2 (EBSF_2) program, which kicked off in 2015 and is financed in part by the European Union.

Learn more on page 13.

MAY 22

DigiHall Days celebrate digital innovation

The first-ever DigiHall Days, organized by LIST, brought together all of DigiHall's partners. More than 1,200 decision-makers from industry and academia came to see 130 high-tech prototypes and demonstrator systems at the 2,000 sq. m exhibition. Attendees got an opportunity to see the latest digital innovations from Paris-Saclay first-hand and tour the campus' new open innovation facilities, TheDesignSpot, FactoryLab, and Additive Factory Hub.



OCTOBER 24, 25, 26

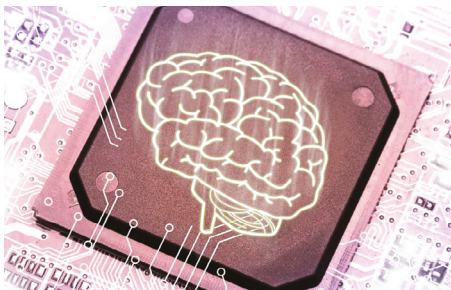
Excellent marks from France's higher education and research evaluation board

LIST was evaluated by France's higher education and research evaluation board (Hcéres). The evaluation report was extremely positive, with LIST earning high marks for its programs to support industry (transportation, healthcare, security, defense, etc.). LIST also earned kudos for its successful performance of contracts signed under French and EU research programs involving partners from academic research and industry.

4 programs that are reinventing innovation

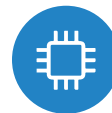


Artificial intelligence



Analyze and process data in real time to offer innovative services across all areas of industry.

Our Artificial Intelligence solutions utilize deep learning algorithms and will support the development of technologies that range from innovative sensors to human-system interaction and big data management tools. The multi-mode interactions developed by our researchers promote “natural” affinities between humans and systems for a more coherent human-information-environment triad.



Cyberphysical systems



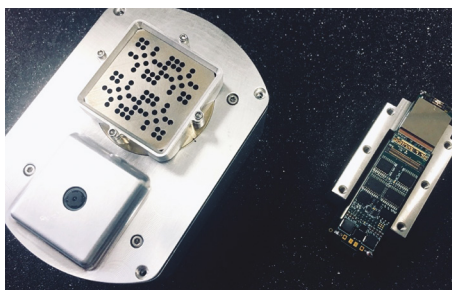
Prepare for future demand for smart embedded systems, dedicated digital architectures, and cybersecurity.

Today's increasingly powerful cyberphysical systems capture flows of data and possess several levels of connectivity, both internally, and with external devices and systems. LIST CPS technologies are distributed, communicating, and flexible—ideal for responding to the substantial data security and economic efficiency challenges inherent to this constantly-evolving field.

LIST's strategy depends on its capacity to offer innovative solutions that meet the needs of all of its partners. The institute is home to 20 technology platforms with state-of-the-art equipment and know-how and runs four major programs: Factory of the future, Artificial intelligence, Cyberphysical systems, and E-healthcare.



Factory of the future



Help industrial companies to manufacture their products with greater agility, performance, and quality.

Making production in all of its forms more efficient is vital to helping industrial companies stay ahead in an increasingly competitive global business environment. Our research focuses on physical and cognitive assistance at all phases of the product design and production cycles. Our tools, which include digital twins, can simulate and streamline production environments and improve safety and ergonomics.



E-healthcare



Make patient care pathways more personalized and efficient.

LIST is bringing its technologies to e-healthcare with advances in AI, interactive systems, and radiation dosage simulations for medical imaging and radiotherapy. The particularly demanding requirements of medical systems and recent innovations in radiotherapy spurred the creation of a new R&D platform, DOSEO, addressing these specific issues.



ARTIFICIAL INTELLIGENCE

→ TOP NEWS

DEEP MANTA: ENHANCED PERCEPTION FOR AUTONOMOUS VEHICLES

“Deep Manta is at the center of one of the promises of AI: totally autonomous vehicles in which the driver’s visual perception is effectively delegated,” said LIST engineer Stéphane David. This patented multi-task deep learning algorithm is capable of identifying objects present in a scene (cars, trucks, bicycles and motorcycles, pedestrians, signs and traffic signals) in real time. The goal is to keep the vehicle (a taxi, for instance) moving on a safe trajectory as smoothly as possible at all times. “Deep Manta offers the added benefits of being fast, reliable, and resource-efficient. Its all-in-one architecture uses much less processing power than task-specific algorithms, which helps reduce the size and energy consumption of embedded systems for autonomous vehicles.” In addition to a groundbreaking partnership with automotive supplier Valeo, Deep Manta is also garnering interest from many other mobility stakeholders, from railroads to mass transit. Smart cities could also turn to Deep Manta for the counting and sensing capabilities needed to drive metrics and streamline flows. —

“ Deep Manta is at the center of one of the promises of AI: totally autonomous vehicles in which the driver’s visual perception is effectively delegated.



EXPLORE ALL OF
OUR 2018 HIGHLIGHTS AT
WWW-LIST.CEA.FR/EN

MORE NEWS



PARIS TRANSIT AUTHORITY RATP, THE CEA, AND IVECO BUS


LIST partnered with Paris transit authority RATP and bus manufacturer IVECO to develop an autonomous positioning system that enables a bus to park in an unprotected environment with no human intervention. SLAM (Simultaneous Localization and Mapping) is used to locate the vehicle. A deep learning algorithm enables visual recognition of markings. The vehicle's precision "smart" parking system is enabled by predictive control with multi-sensor data fusion. A demonstration was completed for industry professionals and the media in March 2018, a great way to showcase LIST's capacity to innovate in advanced manufacturing and transportation. —



NEUROSPIKE ENHANCES PULSE NEURONS

Conventional neural networks (CNN) are enabling new 2D image processing methods. Neurons coded according to a formal model are big energy consumers, which is why LIST and fellow CEA institute Leti decided to come up with a more economical method: pulse-coded neurons. They developed a hardware chain that transposes formal coding to pulse coding and a dedicated architecture, Neurospike—the first-ever calculator that can implement an entire pulse

CNN. Neurospike is four times faster and uses eleven times less energy than today's pulse architectures, opening the door to cost-competitive alternatives to standard CNNs. —

 Learn more at <http://www-list.cea.fr/en/media/news/2018/395-october-1-2018-faster-more-energy-efficient-neural-networks-with-neurospike>

LOCAL HAPTIC FEEDBACK FOR HIGH-SENSITIVITY TOUCH SCREENS

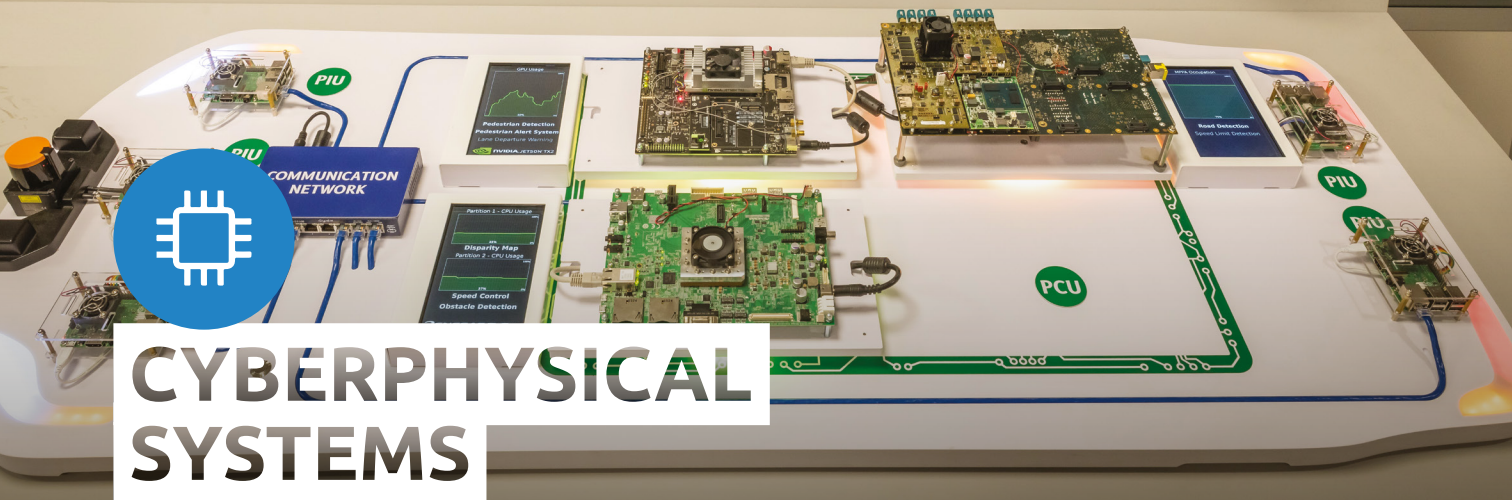
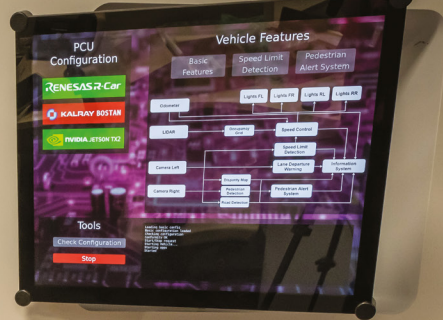
Today's touch screens provide "general" sensory feedback in the form of diffuse vibrations. LIST overcame this lack of sensitivity by using time-reversal wave focalization to generate highly-sensitive precision local signals. The sensory feedback obtained is detailed, accurate, and tunable, for touch sensations that can effectively simulate a virtual button that users can "feel" without having to look at the screen. This innovative concept leverages piezoelectric switches positioned around the screen and capable of producing impulses that travel rapidly and continuously to each point of contact. —



A MULTI-MODE WIRELESS NETWORK THAT CAN GO ANYWHERE

“How do you provide high-speed telecommunications that offer a high level of performance on a very large, constantly-changing construction site where cellular connectivity is not an option?”

One of LIST's industrial R&D partners was facing precisely this issue. To solve the problem, LIST designed a flexible, versatile multi-mode wireless network. Multi-protocol routers are placed at strategic locations and Néon, the embedded software developed for the project, creates the interconnections between the hardware and routes the traffic using the most efficient type of connectivity available at any given time (4G, Wi-Fi, Li-Fi, Ethernet...). This was LIST's first multi-mode network project, and it could apply to other industries as well. —



CYBERPHYSICAL SYSTEMS

→ TOP NEWS

AUTONOMOUS VEHICLES: MAKING ROOM FOR COMPLEX ELECTRONICS

Today's autonomous vehicle prototypes are usually plagued by a plethora of non-interoperable sensors and calculators. The resulting systems are very complex. "Integrating this type of system into a passenger vehicle would require a complete overhaul of the electronic architecture. This is simply not feasible. Which is where the Face project comes in," said LIST engineer Maroun Ojail. "We designed Face with Renault-Nissan-Mitsubishi with the goal of equipping all of their vehicles with a new electrical/electronic (E/E) architecture by 2020." The principle is to simplify the embedded system by creating a new platform compatible with legacy systems but also modular to ensure forward compatibility

with tomorrow's on-demand services and innovative functions. "This project leveraged LIST's knowledge of critical software, processors, and networks. We were able to design a new E/E architecture based on a central calculator connected to secondary calculators that collect data from the sensors (cameras, LiDAR, radar, etc.) and switches (engine, airbags, brakes, etc.)." This novel architecture substantially reduces the number of embedded calculators required, facilitates autonomous vehicle E/E design and implementation, and lays the groundwork for the major transformation just over the automotive industry's horizon. —

“ This project leveraged LIST's knowledge of critical software, processors, and networks.



EXPLORE ALL OF OUR 2018 HIGHLIGHTS AT WWW-LIST.CEA.FR/EN



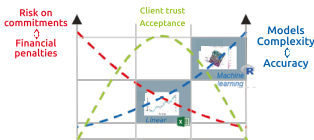
A REVOLUTION IN ELECTRICITY GRID DIAGNOSTICS

A partnership between LIST and Nexans produced Cable-Diag, a solution that detects faults on medium-voltage (20 Kv) electricity grids. The solution applied the acoustic principle of time reversal to passively “listen” to electrical cables and, in the process, identify and locate any significant disturbances. A prototype made up of special sensors and an algorithm to speed up the processing of data was tested in real-world conditions. The tests showed that the solution is both accurate (0.1%) and fast (less than a minute as opposed

to several hours previously). The technology is so efficient that it could potentially revolutionize grid maintenance by enabling faster and more accurate responses to any faults. —

BLOCKCHAIN-BASED ENERGY PERFORMANCE CONTRACTS

The French government created Energy Performance Contracts to help encourage more energy efficient buildings. However, the incentive program has failed to get users on board, mainly because the algorithms used to estimate a building's performance are so complex and users do not know what data will be used or how. Given the potential benefits to society and the economy, Veolia turned to LIST to help overcome this hurdle to the widespread adoption of the Energy Performance Contract system. LIST drew on its deep knowledge of digital technology to develop an original solution that leverages blockchain to provide users with a guarantee of the trustworthiness of the data. The original data and contracts are tamper-proof and can be viewed and audited by independent third parties. The prototype of the solution is undergoing validation testing at a Veolia pilot site. Once testing is complete, the solution could be implemented much more widely. —

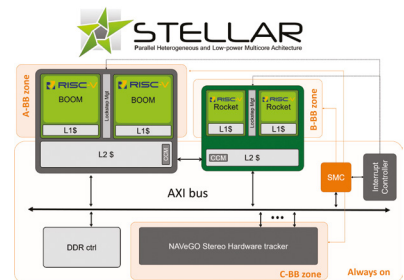


Learn more at www-list.cea.fr/en

AUTOMATED REASONING FOR SOFTWARE CYBERSECURITY VERIFICATION TESTING

Evaluating a software application's resistance to attacks is a key element of the cybersecurity certification process. It is also an increasingly complicated and tedious task for the experts who must carry it out. LIST is prototyping a method to automate the software analysis steps in this process. Automated logical reasoning and symbolic IA are used to exhaustively characterize entire classes of code vulnerabilities. The approach won two awards from NIST (the US Institute of Standards and Technology) and earned LIST's Frama-C analysis platform its stripes in a demanding and highly-technical field.

The platform, used by the CEA for its own projects, has led to scientific talks with French national cybersecurity agency ANSSI and a joint lab with Thales. Ultimately LIST plans to utilize the platform to support pre-certification and certification professionals in their day-to-day tasks. —



HIGH-TECH PLATFORM FOR EMBEDDED PEDESTRIAN NAVIGATION

Tomorrow's innovative embedded applications—like using image analysis to determine the user's position, for example—require fast and energy-efficient data processing. In research conducted under the EU Things2DO project, LIST developed the STELLAR computing architecture to respond to both of these challenges.

The architecture's heterogeneous RISC-V open-source processor cores make it possible to alternate between high performance and low energy modes depending on the system's needs. A solution designed at LIST monitors the platform and manages task switching and voltages and frequencies in the different areas of the circuit in real time for optimal efficiency. Special hardware accelerators can be added to further boost the energy efficiency of certain processing operations. The solution was integrated into smart glasses in partnership with IGN (France's geological survey authority), confirming its potential for pedestrian navigation applications. —



FACTORY OF THE FUTURE

→ TOP NEWS

NANOPIX, THE WORLD'S SMALLEST GAMMA CAMERA

LIST's partnership with ORANO led to the development of a new and advanced high-tech device: a miniaturized version of ORANO's GAMPIX camera. The new Nanopix camera will be used to see radioactive contamination from a distance. "At just 8 cm x 5 cm and 268 g, the new camera is two times smaller and ten times lighter than its predecessor, making it the world's smallest gamma camera. It will be used to equip endoscopes capable of entering holes measuring less than 8 cm, which will facilitate the mapping of highly-contaminated hot cells at the La Hague reprocessing facility," said LIST engineer Vincent Schoepff.

The dimensions of the measurement electronics were reduced by half thanks to advances made in partnership with the Czech Technical

University (CTU) Institute of Experimental and Applied Physics and company X-Ray Imaging Europe. "In situ experiments confirmed a level of performance similar to that of the larger camera over a range of gamma-ray-emitting elements covering most of the nuclear industry's needs." Improvements to the system (embedded intelligence, automating the measurements, self-powering capabilities) will ultimately facilitate the camera's integration into other tools used by ORANO personnel, such as robots and drones. —

2x
smaller
than GAMPIX
(8 cm x 5 cm)

10x
lighter than
GAMPIX (268 g)



EXPLORE ALL OF OUR 2018
HIGHLIGHTS AT WWW-LIST.CEA.FR/EN

+ MORE NEWS

ELECTROMAGNETIC MODELING TO TEST STEEL



Monitoring the state of the microstructures within steel is vital to a number of industries, from energy to manufacturing and more. This is because any alteration of the material's mechanical properties can have serious consequences. Non-destructive electromagnetic testing methods can be used to detect changes in the state of the material at the macroscopic scale. LIST set out to evaluate the sensitivity of these methods and improve them. To do so, the institute developed simulators based on conventional numerical solvers and an original semi-analytical formulation that can calculate the impact of a change in the material's laws of behavior on the electromagnetic measurement. The simulators will be integrated into the CIVA software platform, which will facilitate the transfer of these innovative solutions to industrial users. —

LISTENING TO THE “NOISE” INSIDE PIPES, A NOVEL INSPECTION METHOD

LIST is partnering with French electric utility EDF on a three-year project that aims to validate a novel method for inspecting pipework: passive tomography using guided elastic waves. Two rings of sensors are installed around the area to inspect. This allows the guided elastic waves that naturally propagate in the pipes due to the flow of liquid inside to be measured. The signals obtained are then utilized to generate a tomographic 3D reconstruction of the thickness of the pipe walls. Ultimately, EDF and LIST would like to use fiber optic Bragg sensors, which would enable a lightweight, minimally-intrusive passive monitoring system capable of withstanding extreme conditions (temperatures in excess of 900 °C, radiation, etc.). —

Read the full article at: <http://www-list.cea.fr/en/media/news/2019/423-july-25-2019-listening-to-the-flows-inside-pipes-to-monitor-structural-health>

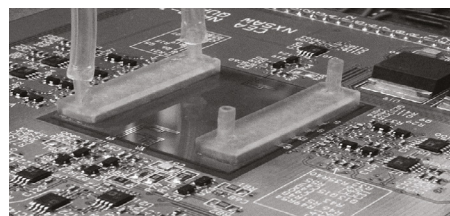


VR SIMULATOR FOR THE NUCLEAR INDUSTRY

EVOC, for Enhanced Virtual Open Core, is a teaching tool unlike any other anywhere in the world, providing a virtual-reality version of a nuclear reactor in operation. The system, which was presented at the World Nuclear Exposition in June 2018, is based on a new kinetic simulator of the reactor coupled with a multi-physics virtual-reality simulator developed by LIST and already in use in actual industrial environments. All of the physical phenomena that take place in a reactor are generated in real time in the VR headset and on the control panel. The result is a strikingly-realistic experience of a highly-complex scene. This impressive technological achievement has potential uses in other industries like aeronautics and medicine, for example. —



Watch the video at: <https://www.youtube.com/watch?v=etGEuvf3pq0&feature=youtu.be>



DIGITAL SLEUTH USES FINGERPRINTS TO IDENTIFY TOXIC CHEMICALS

LIST project Essaim is a cross-disciplinary initiative to develop a complete system to recognize the chemical “fingerprint” of volatile compounds using a multi-sensor surface acoustic wave (SAW) approach. One of the advances achieved by the project team is the development of a solution that leverages novel algorithms: the ClooNEZ software suite, implemented on the PACT sensor and data processing platform. A first software application enables ClooNEZ to gather data from the SAW network; a second software application uses machine learning to run different models that recognize toxic chemical compounds, optimizing the models' performance and selecting the most suitable model for each situation. The real-time use of the model selected is managed by a third and final software application. —



E-HEALTHCARE

➔ TOP NEWS

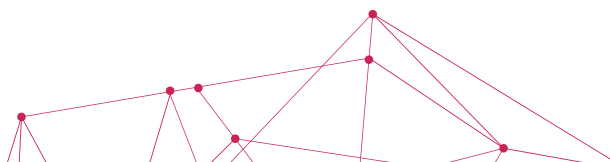
MACHINE LEARNING HELPS PREDICT KIDNEY TRANSPLANT REJECTION RISK

For patients suffering from terminal kidney failure, a transplant is often the best course of treatment. However, transplant rejection rates are high, and invasive biopsies are needed to effectively diagnose rejection. "BIOMARGIN is an international, multi-partner project established to develop non-invasive alternative for the diagnosis of transplant rejection based on the unique molecular signatures of three types of kidney transplant rejection: cellular and humoral immune responses and interstitial fibrosis," said LIST engineer Stéphane Gazut. LIST is contributing software and statistics technologies to the project. "We have developed a complete processing chain that integrates machine learning to select the main markers of interest based on an analysis of a large number of multiomic databases (RNA, proteins, metabolites, etc.) provided by our partners." LIST also designed and validated the models used to predict rejection based on the identification of characteristic signatures from blood or urine samples. —

“ The models, currently in the clinical testing phase, will enable innovative tools to assist practitioners in diagnosing rejection and, in the near future, help improve transplant patient outcomes.



EXPLORE ALL OF
OUR 2018 HIGHLIGHTS AT
WWW-LIST.CEA.FR/EN



MORE NEWS



HIFU: ENHANCED SIMULATION IMPROVES TREATMENT


High-intensity focused ultrasound (HIFU) is an innovative, minimally-invasive treatment that uses the energy in an ultrasound beam to destroy the cells targeted without damaging adjacent tissues.

LIST, in partnership with INSERM, developed the CIVA-Healthcare simulation platform, which can accurately estimate the dose delivered and the lesion created depending on the equipment, treatment protocol, and the patient's biological characteristics.

This generic solution was then used as the basis for a tool that can be integrated into FocalOne®, a medical system developed by EDAP-TMS for prostate cancer treatment. It is currently in the validation testing phase. Ultimately, it will allow caregivers to personalize HIFU therapy in real time to treat the most common form of cancer in men. —

TOTAL CONFIDENTIALITY FOR EUROPEAN HEALTH RECORDS

Kofindo is a far-reaching international project that aims to secure the transfer of medical data within Europe. LIST came up with an approach based on homomorphic cryptology, which ensures that data has not been tampered with during processing or transfer. Feasibility tests of a blind-translation prototype running on the Cingulata open source environment for the processing of homomorphically encrypted data were encouraging, and the solution tested proved to be both fast and efficient. The prototype could be used to develop and implement other use cases. —

 Learn more at <https://github.com/CEA-LIST/Cingulata>



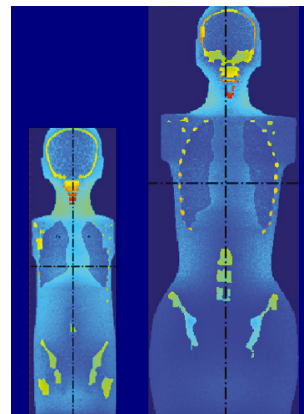
BETTER DOSE CONTROL FOR ELECTRON BRACHYTHERAPY


Electron brachytherapy is used in the treatment of breast cancer. During surgery, a miniature X-ray source is inserted into or very close to the tumor. The technique offers a number of advantages in terms of accuracy, comfort, and cost. In response to recommendations issued by French healthcare authorities to better control the doses delivered to patients, LIST established an independent dosimetry reference for the only generator available in France, the Zeiss Intrabeam®. The method developed by LIST ensures that the photon emissions generated by the applicator are characterized and reproduced identically. It can be used with any intraoperative radiation therapy equipment and will help caregivers check traceability and reliability themselves without having to rely solely on manufacturers' data. —



NEW PATIENT DOSIMETRY AND IMAGE QUALITY INDICATORS FOR MORE EFFICIENT MEDICAL IMAGING

Repeated medical imaging tests can expose patients to risks—like radiation-induced cancer—down the road. The drive to reduce radiation dosages without negatively affecting diagnostic quality led LIST to design an innovative approach leveraging two powerful metrics generated using advanced algorithms. The first is the 3D distribution of the dose received by the patient obtained using a Monte Carlo model of the imager at the DOSEO platform. The second is image quality calculated using a mathematical model that “observes” the level of detection of the imager. The combined use of these two metrics is one of the first building blocks of a method that can evaluate and improve medical imaging protocols. —



 Learn more at <http://www-list.cea.fr/en/media/news/2019/416-may-23-2019-medical-scans-reducing-doses-without-compromising-on-diagnostic-quality>

STARTUPS, tech-transfer facilitators

LIST research has spawned 22 startups. These companies, founded primarily by LIST scientists, have created more than 300 jobs.

LIST startups develop and commercialize solutions and services that leverage generic technology bricks developed at LIST. They play a key role in facilitating the transfer of LIST's know-how and innovations to the businesses that need them.



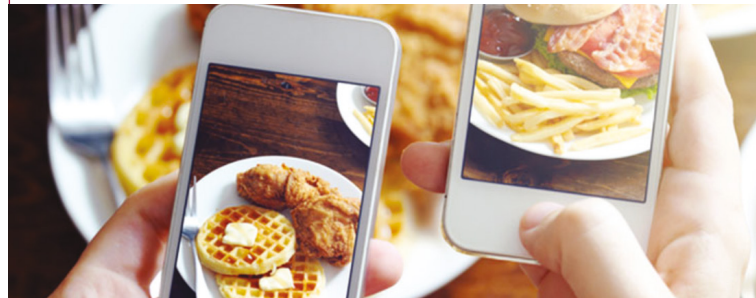
Sport Quantum was selected to receive funding from angel investor network Réseau Entreprendre Essonne in 2018. The company's piezoelectric-sensor-based technology can locate the point of impact of a projectile to within 100 microns. Sport Quantum is emblematic of the digital transformation of target shooting sports and is now pursuing opportunities on international markets. The company kicked off its first crowdfunding campaign on the Sowefund platform and is seeking additional funding from angel investors.



Connecting Food, which has nine employees, offers a food-industry compliance audit solution. The supply chain outlined in a food product's specifications is tracked in real time using blockchain—which guarantees transparency for greater consumer trust. A prototype of the startup's Live Audit solution was successfully tested with a major food manufacturing company and was released on the market in early 2018.



Tridimeo specializes in ultra-rapid industrial 3D vision solutions that make it possible to automate quality inspection and complex guiding processes. In 2018 the company won the EIT Health "HeadStart/Proof of Concept" award for applications in dermatology and remote dermatology. Tridimeo was also selected in the Industry of the Future category of the Innov'Up Leader PIA call for projects financed by the French national and Île-de-France regional governments in September. The startup also won the Incuballiance 2018 award for government research/best tech transfer.



WiseBIM develops AI solutions for the automated generation of 3D Building Information Models (BIM) from 2D architectural drawings. The technology allows all construction-industry stakeholders to work from interoperable models.

In 2018 WiseBIM won the NETVA (New Technology Venture Accelerator) competition run by the French European and Foreign Affairs Ministry, the Vivatech RATP challenge, and a call for projects on nuclear decommissioning organized by electric utility EDF.



Isybot designs collaborative robots built on CEA research. The company's cobots help make repetitive manual tasks, including those not previously deemed automatable, more efficient and less taxing for operators without modifying the work environment. The company, a partner of FactoryLab, raised nearly €1 million in capital from investment funds Calao Finance, CEA Investissement, and Scientipole Capital. Isybot sold its first products (collaborative robotic sanding arms) in late 2018 to Dassault Aviation and French national railway operator SNCF.



Kalray, a pioneer in processors for smart systems, completed a €48 million IPO in early 2018, winning the Euronext IPO 2018 Award in the mid-cap category. The company continues to ramp up its sales development, and has garnered substantial interest from the automotive industry. In May 2018, Kalray's solutions were integrated into Renault's Symbioz® electric autonomous concept car. In September Kalray demonstrated the efficiency of its Massively Parallel Processor Array (MPPA®) architecture using the Baidu Apollo open software platform for autonomous vehicles. In December Kalray joined the Autoware Federation to facilitate the rollout of technology for autonomous vehicles.



Arcure develops smart sensors to take driverless industrial vehicles to new levels of autonomy. Ten years after launching its first prototype, the company is now celebrating the production of its 4,000th Blaxtair embedded stereoscopic-vision-based pedestrian detection system. Arcure also created a new product in 2018: Omega, the company's new smart stereoscopic camera, targets systems integrators. It can reconstruct the environment around the sensor in 3D and in real time.

FOCUS ON CARFIT



Carfit develops a real-time monitoring technology for cars that will enable smart maintenance systems. The startup formed a joint lab with LIST in 2018 to develop AI methods capable of identifying signs of mechanical failure from a vehicle's vibration data.

3 FOUNDATIONAL PROJECTS, an international strategy

LIST is a key stakeholder in a number of far-reaching projects. These partnerships were established to effect the profound transformation of industry and to initiate new fields of innovation backed by the know-how and tech-transfer capabilities our partners need, both nationally and internationally.



THE POWER OF 3D PRINTING

The Additive Factory Hub (AFH) opened its doors in late 2017. This collaborative research platform is dedicated to additive manufacturing techniques and develops, evaluates, and integrates the technologies supplied by its partners: digital toolchain, materials, processes (SLM and WAAM), AI, monitoring, NDT, and certification.

AFH is located on the Paris-Saclay campus. It provides a single physical location for the diverse resources and know-how needed to run advanced multi-industry R&D projects on additive manufacturing. The platform facilitates research, the dissemination of research results, and education and training to support the growth of France's industrial economy.

Around 20 industrial and academic stakeholders (including AFH's ten founding members) are united in their pursuit of three main objectives:

- ▶ reach the scientific and technological milestones needed to ensure the competitiveness of AFH partners from industry and to disseminate the work of its scientific and academic research partners,
- ▶ demonstrate the feasibility and advantages of additive manufacturing for industrial applications,
- ▶ support SMBs in the Île-de-France region to ensure that they can integrate the technologies developed.

AFH will ultimately house fifteen additive manufacturing machines for a total investment of €20 million, financed in part by the Île-de-France Regional Council.

“ AFH positions LIST to transpose its non-destructive testing and in-line inspection technologies to additive manufacturing processes in close cooperation with the other CEA institutes and, especially, Liten, which specializes in new technologies for energy and in nanomaterials.



Accelerating innovation in 3D

- End 2017: Financing from Île-de-France Regional Council secured
- July 2018: Consortium Agreement signed by ten founding members
- September 2018: First 3D printer received and first floor completed
- October/November 2018: First projects start, including two led by LIST

€3 M
in projects
started

20
partners

5
feasibility studies
started

9
new
members

5
innovation projects
started



FactoryLab

La communauté pour
l'industrie du futur

THE INDUSTRIAL TRANSFORMATION CATALYST

A community of stakeholders from academia and industry coordinated by LIST, FactoryLab was established to facilitate communication and resource-sharing across industries, positioning members to respond to the challenges of the industry of the future.

FactoryLab is located on the Saclay campus. It is a space where end users and the R&D ecosystem (represented by technology suppliers, major corporations, SMBs, and academic stakeholders) can come together. The goal is to develop and integrate mature technological solutions that meet industrial companies' needs within an eighteen-month time horizon.



A founding member, LIST acts as a research partner, providing scientists, and as coordinator, running day-to-day operations.

A CLOSER LOOK... THE TELEMATICS PROJECT

The Telematics project aims to demonstrate that remote operation can have benefits when applied to complex, high-added-value robotized tasks. Remote handling systems using master arms operated by humans for complex operations or in difficult-to-access locations were evaluated as part of this project. LIST's cooperation with TechnipFMC on this project resulted in the validation of a system capable of changing skids mounted on underwater ram closures at sea and with no direct human intervention.

DIGIHALL

CENTER FOR EXCELLENCE IN DIGITAL TECHNOLOGY FOR THE ÎLE-DE-FRANCE REGION



A vibrant interdisciplinary community, DigiHall's research focuses on AI, cyberphysical systems, and the Factory of the Future.

AI is DigiHall's core research field, and one that will empower new data-driven innovation models. AI has the potential to make products, processes, and services more efficient in all areas of industry. In particular, AI can help small and medium-sized businesses remain competitive.

3 PILLARS

- Ambitious technology platforms to support R&D in advanced manufacturing, AI, cyberphysical systems, and digital trust.
- A design-driven and user-centered approach through the activities at the Design Spot on the Paris-Saclay campus.
- Research and innovation professionals from the public and private sectors working in close proximity at all stages of the research and innovation lifecycle.

3

approaches: research and technology, UX and design, SMBs and large corporations

1,500

research scientists and engineers working together to develop the digital tools of tomorrow

50,000 SQ. M
at Nano-INNOV



CONTACT

Institut LIST | CEA Saclay Nano-INNOV
F-91191 Gif-sur-Yvette Cedex
France

info-list@cea.fr | +33 1 69 08 05 14
<http://www-list.cea.fr/en>