



PRESS KIT 2022

ENERGY
DIGITAL
HEALTHCARE

FOREWORD



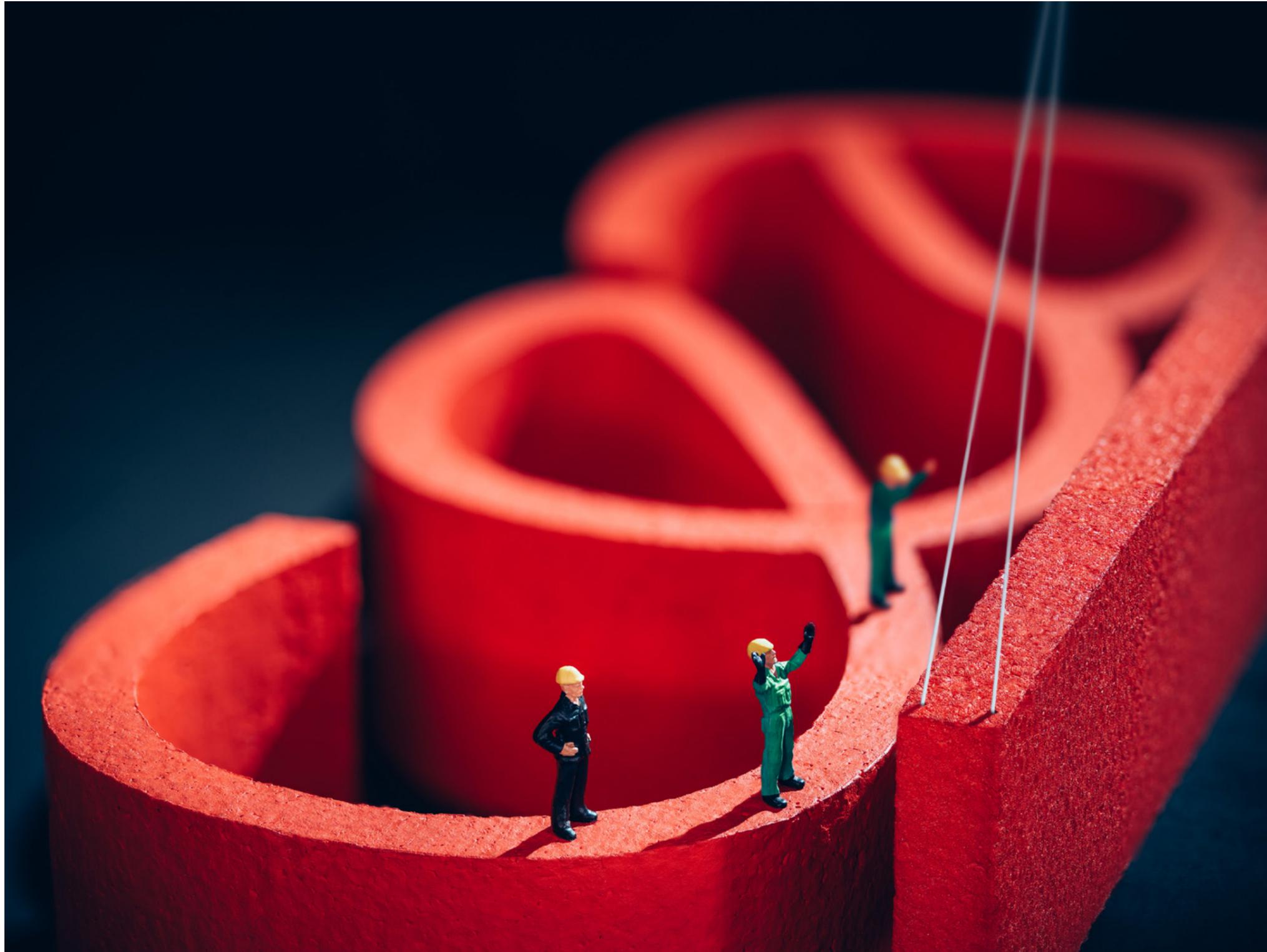
Some of the major research and development happening at the CEA is in service to the digital transition. In fact, these activities occupy a major position in the CEA strategy plan approved by the French government in May 2019. Not only will digital technology be crucial to addressing grand challenges like the energy transition and the medicine of the future, our sovereignty and prosperity will depend on how successful we are at ensuring broad access to these technologies across all subsegments of the economy and society.

In 2020 I initiated a review of our digital technology strategy, starting with an organization-wide inventory of our strengths, which we benchmarked against the world's other major research organizations. We also began to draw the contours of our digital technology research and development for the coming years. The idea was to identify the strategic research areas that would position the CEA to step fully into its role of supporting France's industrial economy while addressing the environmental and societal issues raised by the adoption of digital technology and maintaining the organization's scientific and technical depth.

Guiding the responsible implementation of digital technology and ensuring France's sovereignty on technologies vital to the nation's strategic independence and the resilience of its economy are no small tasks.

Our digital technology strategy sets forth our main research and development goals, of course. But it also outlines the resources we will deploy in service to this mission. Some of these resources will be used to generate synergies both within our organization and with our research partners, primarily in France and other European countries.

François Jacq
Chairman, CEA



The CEA is a key player in research, development and innovation in four main areas: energy transition, digital transition, technology for the medicine of the future and defense and security. With a workforce of 20,000 people, based in nine sites equipped with very large-scale research infrastructures, the CEA actively participates in collaborative projects with a large number of academic and industrial partners, in France, Europe and worldwide.

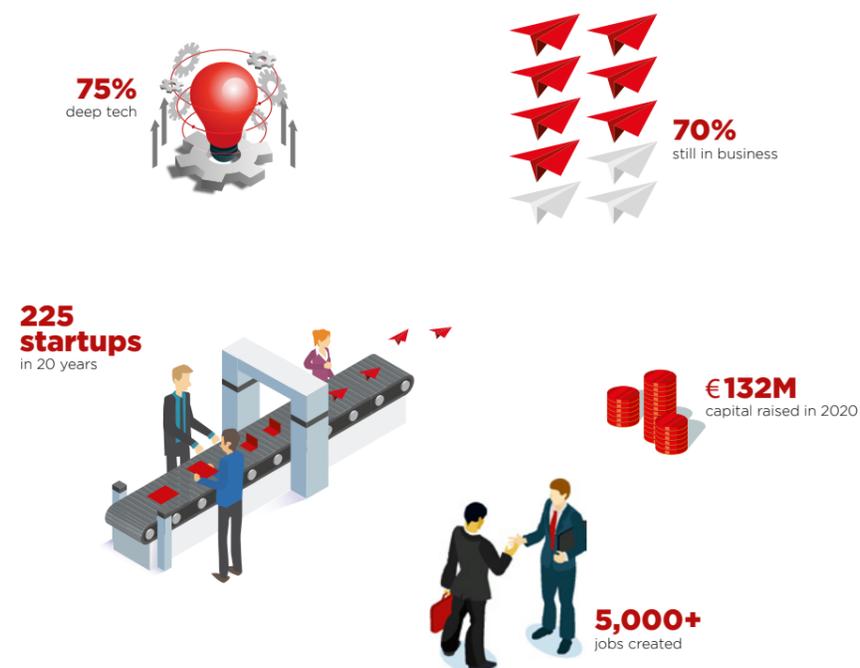
TECHNOLOGICAL EXPERTISE

The CEA acts as catalyst and driving force for innovation to boost French industry. We help businesses in all sectors be more competitive, creating high-performance products that stand out from the crowd and developing trail-blazing solutions that lead to changes in our society. We deploy this dynamic approach at sites all over France, aiding local partners to innovate themselves, thus helping to create sustainable value and jobs nationwide, tailored to meet actual industry needs. Alongside this, the CEA provides more than just a kick-start to our 215 startups, agile vectors for transferring the disruptive technology and knowledge developed at our laboratories to industry.

For more information: www.cea.fr/english

CEA STARTUPS POLICY

The CEA has been creating tech startups for more than 20 years.



CREATING SUCCESSFUL, SUSTAINABLE STARTUPS TO BRING OUR TECHNOLOGIES TO THE MARKET IS ONE OF OUR CORE MISSIONS.

Over the past two decades, the CEA has earned recognition for its support of emerging tech companies through a proactive startup strategy. Today, startups—the right choice for disruptive, high-risk technologies that address burgeoning market segments—are a key pillar of the CEA’s technology transfer strategy. The CEA’s new Magellan Startup accelerator will double the number of startups created every year.

Leveraging the CEA’s broad IP portfolio (CEA is France’s first European patent depositor and holds above 7000 active patent families), CEA startups bring disruptive hardware (microelectronics and integrated systems) and/or software (artificial intelligence) to the energy, medtech, digital technology, cybersecurity, cleantech, and biotech markets.

And CEA startups play a key role in the development of new industries. A particularly outstanding example is the development of the silicon-on-insulator (SOI) industry by Soitec, a CEA startup

that is now a publicly traded company that employs some 1,700 people. The company’s SOI substrate, initially developed in CEA labs, is well on its way to becoming the standard for IoT.

The CEA can also be a valuable accelerator for technology startups, especially in the early stages of their development. For growth-stage startups, the CEA can become a long-term partner, providing a broad palette of technical services (access to R&D platforms), innovation services (intellectual property/patents, strategic marketing, and market intelligence), and a vast network of industrial companies and financiers from the public and private sectors.

In 2017, the CEA and Amundi founded Supernova Invest, which manages a total portfolio of €250 million in support of startups from bootstrapping to venture capital.



DEMONSTRATORS



FOLLOWKNEE

MULTI-SENSOR SYSTEM FOR KNEE IMPLANTS: DETECTS INFECTION AND FACILITATES SURGERY AND REHABILITATION

? WHAT IS FOLLOWKNEE?

CEA-Leti is excited to introduce FollowKnee, a smart integrated multi-sensor system for knee implants that drastically reduces the risk of revision surgery. FollowKnee provides reliable data leveraging three sensors and an accelerometer. The data collected facilitates knee surgery, post-op care, and rehabilitation:

- **More accurate fitting**
Deformation sensor and accelerometer: help the surgeon position the implant more accurately.
- **Early detection of infection**
pH and temperature sensors: detect infection early, a world first.
- **Detection of mechanical troubles issues**
Deformation sensor and accelerometer: trigger an alert in the event of loosening or deformation.
- **Better rehabilitation**
Accelerometer and deformation sensor help physiotherapist better adapt therapy.

DEMO @ CES 2022

The sensors, electronics, and reader integrated by CEA-Leti will be presented in a clear acrylic column representing a leg fitted with a complete knee prosthesis. A tablet will display the data collected by the sensors.

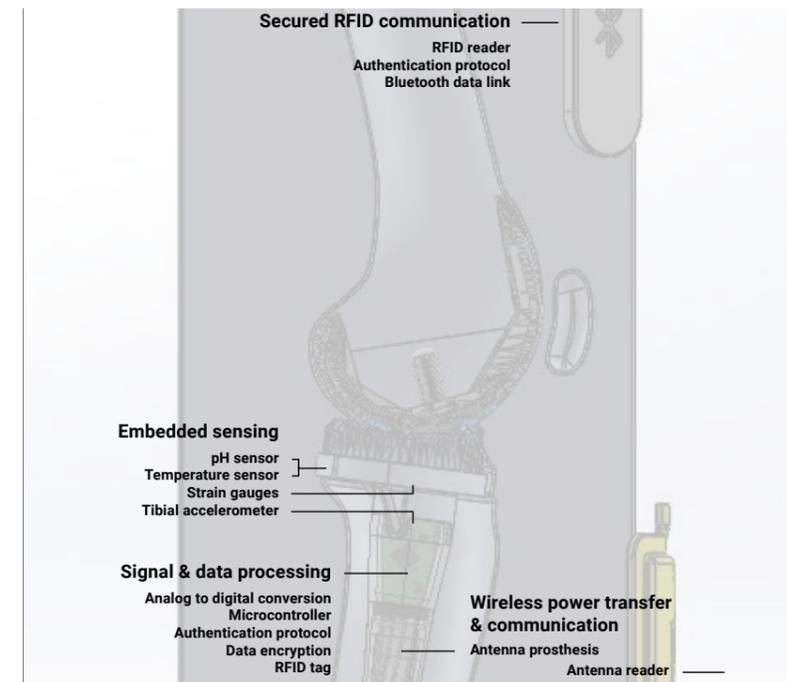


! WHAT'S NEW?

CEA-Leti's team leveraged its solid expertise in sensor and integration technologies to develop:

- The first pH sensor in contact with living tissue to detect infection
- The first low-power deformation sensor
- A biocompatible system
- Highly compact electronics powered via inductive coupling

The sensors and electronics are integrated into the titanium tibial baseplate.



SCIENCE FOR A BETTER FUTURE

Patients: More accurately fitted implants, earlier detection of infections and loosening, better rehabilitation.

Healthcare professionals: Access to new data that can be used to improve surgery, reduce the risk of revision surgery, and improve rehabilitation.

Insurers: Fewer revisions and the associated cost overruns.

Manufacturers: An ultra-miniaturized multi-sensor system, an easy-to-manufacture deformation sensor.

INTERESTED IN THIS TECHNOLOGY?

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APPLICATIONS

- Knee replacement
- Hip replacement
- Shoulder replacement

KEY FIGURES

- 1 patent
- +673% increase in knee replacements expected by 2030
- +3.5 million increase in surgeries worldwide

(source: The Center, Orthopedic & Neurosurgical Care & Research, Bend, Oregon)

>> WHAT'S NEXT?

- Mechanical and functional testing in progress
- Keep the partnership with the University hospital, Brest, France.
- Additive manufacturing (3D printing) of FOLLOWKNEE
- An augmented reality surgical assistance solution to improve fitting of the implant.
- Partnership with a manufacturer available

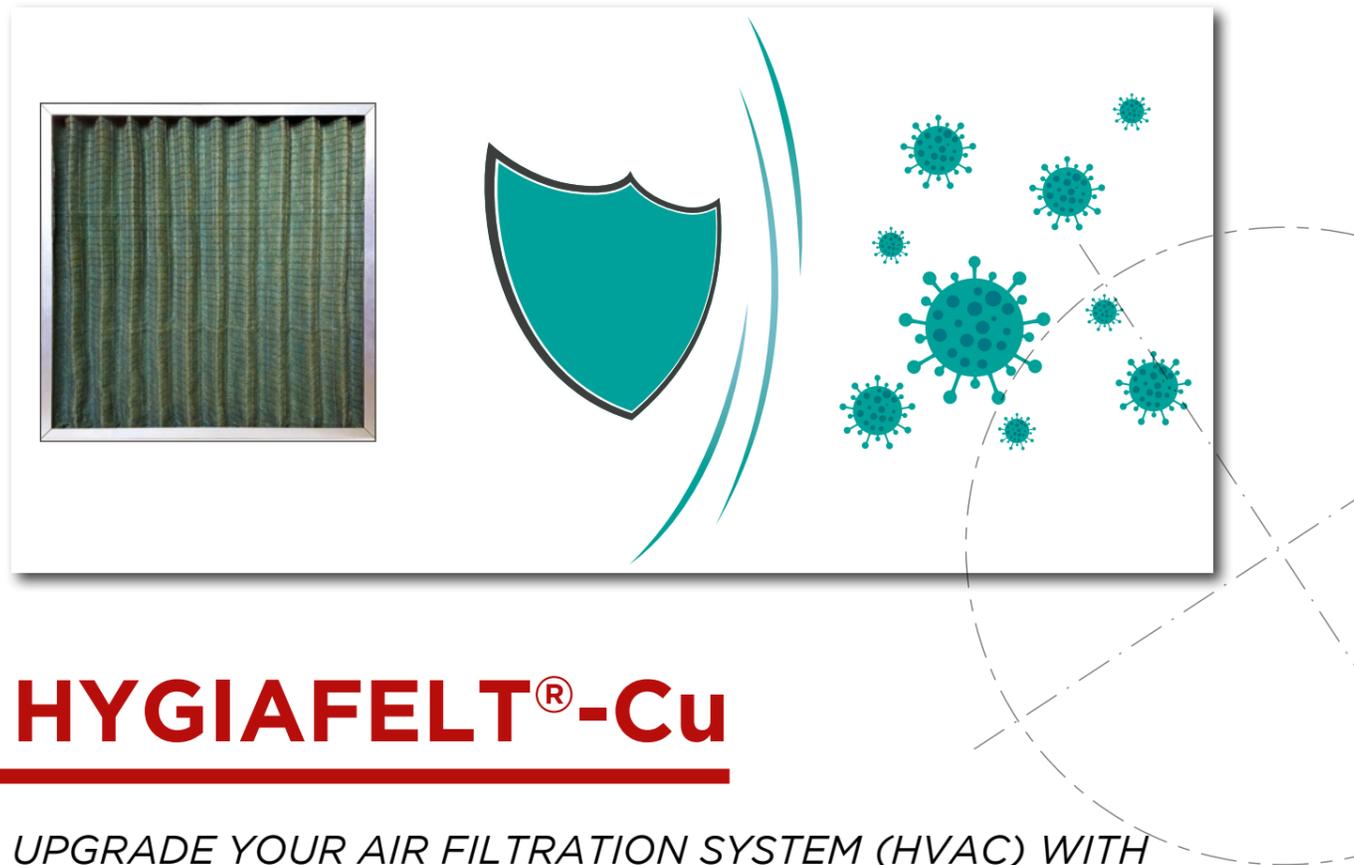
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STARTUPS





HYGIAFELT®-Cu

UPGRADE YOUR AIR FILTRATION SYSTEM (HVAC) WITH HYGIAFELT® FILTERS FOR HIGH EFFICIENCY PATHOGEN CONTACT KILLING ACTION

? WHAT IS HYGIAFELT®-Cu?

Hygiafelt®-Cu is a new antimicrobial filtering media by Ajelis, an innovative France-based company that specializes in engineered textiles for water and air pollution control. Ajelis has developed a method for loading fibers with copper in a stable and secure way. Copper possesses potent biocidal properties. Here, the copper-loaded "contact killing" filtering media traps and neutralizes bacteria, viruses, fungi and spores. Hygiafelt® is nanoparticle-free and does not emit any secondary compounds. Self-decontaminating and reusable, Hygiafelt® is sustainable. The filters are machine washable and can also be sterilized in a medical autoclave to comply with cleaning requirements. Biocidal efficacy: Hygiafelt® is proven effective against microbial colonies such as *Staphylococcus aureus*, *Klebsiella pneumoniae* (AATCC 100 tests by Eurofins), *Escherichia coli* (tests by the CEA in Fontenay-aux-Roses); antiviral efficacy was demonstrated on the human *coronavirus HCoV-229E* (ISO 18184 tests by Biotech Care).

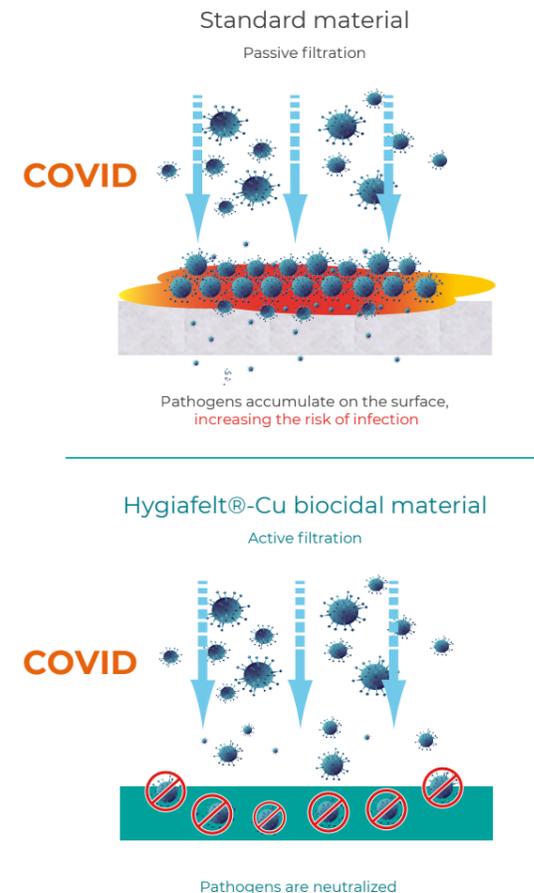
DEMO @ CES 2022

Hygiafelt® comes in wound cartridges for water and on standard or custom-made galvanized steel frames for air (air conditioning and ventilation, portable air purifiers, vacuum cleaners).



! WHAT'S NEW?

Hygiafelt®-Cu is a hybrid solution that filters particles and kills microbes. It is ideal for upgrading fixed and portable air handling units (AHUs) and other equipment.



APPLICATIONS

- **Air Handling Unit (AHU) filters for:** high-rise office buildings, open office spaces, public and commercial buildings
- **Wall-mounted air conditioner filters:** hotel rooms, etc.
- **Mobile air purifier filters:** buildings not equipped with AHUs, classrooms, etc.
- **Industrial vacuum cleaner filters:** large hotels, office buildings, etc.
- **Personal protective equipment (PPE) filters:** respiratory masks
- **Water disinfection cartridges**

KEY FEATURES

- Production capacity: **500 m²/week**
- **5x** more air permeable than standard HEPA filters
- Over **14,000** masks sold or donated
- Over **250 m²** installed on tertiary and military HVAC equipment
- Material can be reused **50+** times

SCIENCE FOR A BETTER FUTURE

Hygiafelt® provides a greater degree of health security for high-rise office buildings. It is easy to install on existing HVAC and AHU equipment without costly retrofitting. Hygiafelt® offers broad-spectrum protection against biological pathogens for better air treatment. As vaccination rates rise and masking decreases, Hygiafelt® is a new weapon in the public health arsenal building owners and operators can deploy.

INTERESTED IN THIS TECHNOLOGY?

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>> WHAT'S NEXT?

Commercialize the product and ramp up sales. Secure contracts with air filtration companies, distributors, and end customers. Target customers: occupational safety health and environment managers, facility managers, high-rise building managers, public and commercial building managers, prime contractors, insurers.



Ajelis is a CEA spinoff.



ALKALEE

SHAPE YOUR CREATIVITY, DRIVE THE FUTURE

? WHAT IS ALKALEE?

Artificial intelligence and connectivity are revolutionizing the mobility industry by enabling new vehicle services and use cases. Today's automotive electrical and electronic (E/E) architectures, developed over more than 35 years of incremental innovation, are not agile or efficient enough to support emerging technologies.

Renault and the CEA planted the seeds of startup Alkalee when they collaborated on the design of a new generation of interoperable and modular E/E architecture for tomorrow's connected and autonomous vehicles.

Alkalee's solution allows users to design modular and real-time ECUs and systems that include multiple very complex and versatile applications, including AI-based systems. Embedded software ensures real-time and operating safety during execution, and a software suite and associated toolchain offer complete design and programming capabilities

DEMO @ CES 2022

Alkalee will be showcasing a new generation of automotive ECU. The functional model presented will highlight how compact and modular the ECU is. Here, the demonstrator will include critical and heterogeneous functions distributed on several processors with a motherboard/daughterboard architecture. The demonstrator will illustrate the benefits Alkalee's software and toolchain can bring to automotive E/E specifications, integration, and verification of software functions.

! WHAT'S NEW?

Alkalee's solutions are built on a mathematical model used to formally express and analyze the interactions between a vehicle's different functions. This model runs across all of our tools from managing the target system's specifications to proving correct implementation. Our supervision system, integrated into the vehicle, measures drift from the desired behavior and applies palliative or corrective measures as needed.



APPLICATIONS

Alkalee provides solutions for companies operating in the mobility industry, where the demand for smarter, more autonomous vehicles is on the rise.

- Automotive
- Trucks and shuttles
- Construction and farming equipment
- Automatic Guided Vehicles
- Defense

KEY FEATURES

- **20 million** invested in R&D
- **<3** months to add a new service
- **6** exclusive patent licenses held
- Unlimited application providers
- Cuts the time and costs of E/E integration validation and testing by half

SCIENCE FOR A BETTER FUTURE

Alkalee addresses some of the major challenges facing the mobility industry. With solutions that allow application developers to access next-generation E/E architectures, Alkalee is helping speed up the digitalization of vehicles. Alkalee's software and toolchain ensure fast, safe integration of heterogeneous applications. Sharing computing power and data also supports value creation and vehicle customization to meet customers' needs.

>> WHAT'S NEXT?

- Date founded: July 2020
- Trial license (SaaS) available: February 2022
- Co-integration services for customer vehicle design: May 2022
- ASIL B (Automotive Safety Integrity Level) certification: October 2022
- GPU accelerator monitoring support: December 2022

INTERESTED IN THIS TECHNOLOGY?

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DIRECT'FIELD®

DIRECT ANALYSIS DEVELOPS DNA EXTRACTION SOLUTIONS FOR FASTER, EASIER, AND SAFER MICROORGANISM DETECTION

WHO IS DIRECT ANALYSIS?

Direct Analysis, a CEA-Leti startup, initially developed Xtralzy®, a fast, easy-to-use lab-on-chip, to meet the food manufacturing industry's bacteriological testing needs.

Integrating Xtralzy® into a PCR or other biomolecular testing protocol can produce results four times faster.

Early detection of pathogens in food plants can help prevent human infection and reduce product recalls and discards



DEMO @ CES 2022

Direct Analysis will unveil its new Direct'Field® reader at CES® 2022. This revolutionary portable device prepares the sample and reads the DNA amplification test right at the sample collection point. Combined with our Xtralzy LD® consumables, our reliable and easy-to-use reader makes detecting and identifying bacteria simple: Just insert the chip into the Direct'Field® reader to get the test results.



WHAT'S NEW?

A simple consumable integrates sample preparation and isothermal DNA amplification, for a solution that is both easy to use and extremely sensitive.

The Xtralzy LD® consumable lab-on-chip and compact Direct'Field® reader will bring the food manufacturing industry an efficient and cost-effective approach to microbiology testing.



APPLICATIONS

- Food manufacturing
- Environmental testing
- Cosmetics
- Pharmacology

KEY FIGURES:

- **600 million** people per year affected by food poisoning worldwide
- Market estimated at more than **\$3.5 billion** by 2026
- Produces results **4x** faster than conventional testing
- Reduces CapEx by a factor of **10**

SCIENCE FOR A BETTER FUTURE

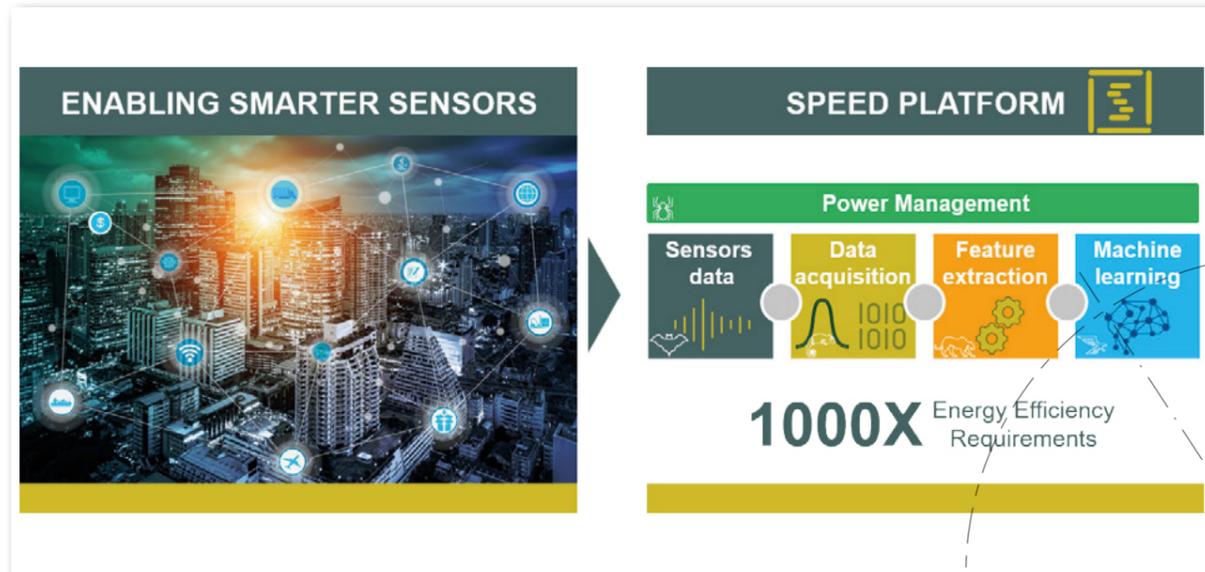
According to estimates, 600 million people are affected by food poisoning each year. Making testing technology simpler and more accessible will enable broader use in the field by non-specialists. And more tests and faster results mean safer food. The technology developed by Direct Analysis can rapidly detect the three main bacteria responsible for food poisoning: Salmonella, E. coli, and Listeria. Real-time testing results will help limit the warehousing and shipping of contaminated products, reduce product recalls, and increase manufacturing productivity for tangible financial benefits.

WHAT'S NEXT?

Direct Analysis plans to develop a solution for labs to test for microorganisms in water (for environmental monitoring, pharma, and cosmetics).

INTERESTED IN THIS TECHNOLOGY?

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SPEED

SPEED RESPONDS TO THE CHALLENGE OF ENERGY EFFICIENCY FOR AI-ENABLED DEVICES

? WHAT IS SPEED?

SPEED is an IP platform that combines analog/mixed signal and digital IPs to enable highly energy efficient AI-enabled devices. SPEED includes:

- SPIDER power management
- BAT audio codec
- CHAMELEON MCU subsystem
- PANTHER multicore versatile DSP processor
- RAPTOR neural processing unit accelerators

These IPs were designed to tackle the energy efficiency challenge created by AI-enabled devices, which are either battery operated or have tight power constraints. SPEED elegantly combines fine-grained, adaptive power management with DSP and AI accelerators.

The best-in-class embedded AI capabilities of SPEED IP were made possible by Dolphin Design and CEA-List. It offers the best tradeoff in terms of SW flexibility, energy efficiency, and peak performance for Edge AI devices by leveraging CEA-List's PNeuro® AI hardware and N2D2 /SESAM tools.

DEMO @ CES 2022

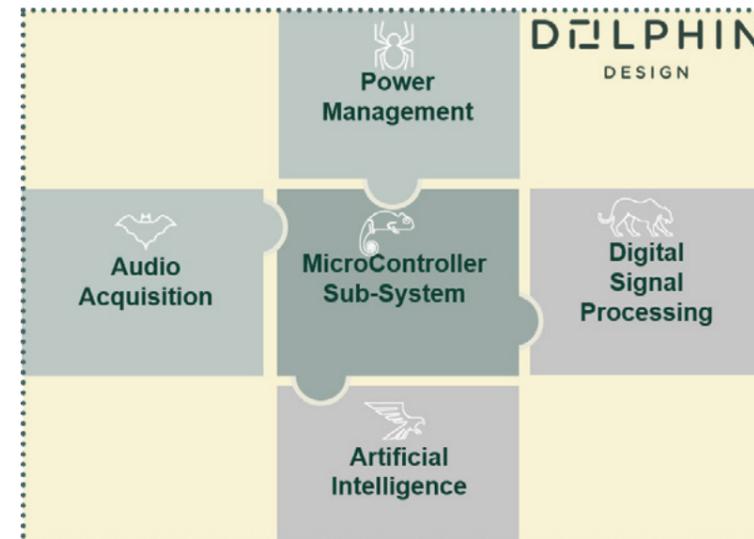
To demonstrate the gains, a demochip has been designed.

Demonstrations based on TinyML benchmarks are showcased @ CES 2022



! WHAT'S NEW?

SPEED is innovative in that it combines the processing of audio and video in a battery-powered system.



These features enable a level of performance previously only achievable on cloud or GPU-type systems. Performance has been demonstrated on a SoC designed using SPEED.

APPLICATIONS

- Smart cities
- Image and activity analysis
- Smart sensors
- Gesture recognition
- People and face detection
- Augmented and virtual reality
- Industry 4.0
- Audio (keyword detection)

KEY FEATURES

- >110 ULPMark-PP score in 22nm node
- 3x less energy for Signal Processing compared to state-of-the art DSP
- Near-memory computing CNN accelerator up to **128MAC/cycle**
- Adaptive Voltage and Body Bias IP
- In-chip margin monitoring

SCIENCE FOR A BETTER FUTURE

Processing by algorithm using low-power solutions will be crucial to coping with the data deluge created by 5G and IoT. It is estimated that 75% of data will be processed on Edge devices rather than in data centers by 2025. AI-based Edge computing, ideal for use in addition to cloud computing, can reduce data transmission by a factor of 20:1 and cut costs by two thirds.

>> WHAT'S NEXT?

To support the rollout of SPEED, we will also release a new generation of our ultra-low-power neural network algorithms in July 2022. Our next release, expected in September 2022, will be a very-low-power signal processing IP to extract features upline from the neural network.

INTERESTED IN THIS TECHNOLOGY?

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ULTRA-MINIATURIZED MICROBATTERY FOR MEDICAL DEVICES

LET'S POWER DIGITAL HEALTH TOGETHER!
SAFE, RECHARGEABLE, HIGH ENERGY DENSITY
MICROBATTERY TECHNOLOGY

? WHAT IS INJECTPOWER?

Medical implants present a particular challenge when it comes to power. As implants get smaller, it becomes more difficult to ensure sufficient energy density for long-term operation.

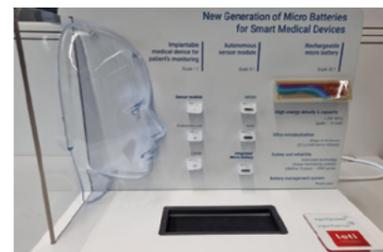
Injectpower solves this problem with an innovative, safe, rechargeable, high energy density, reliable solid-state microbattery technology. It offers unprecedented energy density on an ultra-thin substrate.

The technology is the result of more than sixteen years of research and development at CEA-Leti, a major international research organization located in France.

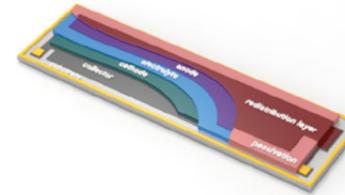
Power management is optimized to extend battery life, enabling the kind of continuous operation required for medical devices. Testing has confirmed a 1,000-cycle, ten-year lifespan.

DEMO @ CES 2022

We will present the world's first and smallest high-energy-density microbatteries developed specifically for implantable medical sensors. Specifically, we will demo our solution on intraocular and intracranial pressure measurement for glaucoma and chronic neurological conditions, respectively.



! WHAT'S NEW?



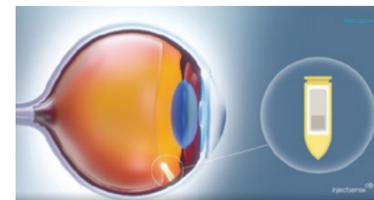
Injectpower is the world's smallest and most integrated rechargeable battery.

Around 80 million people worldwide are concerned by Glaucoma, and it is a leading cause of blindness.

Injectpower is a key enabler of remote intraocular pressure monitoring, part of the solution to tackle this global health challenge.

Injectpower will also find applications in neurosurgery and the treatment of cardiovascular disease, enabling real-time continuous monitoring to improve our understanding and treatment of chronic illness.

Our ultra-thin microbattery can make implantable medical devices (neurostimulation, cardiology, etc.) smaller and self-powering.



APPLICATIONS

- Intraocular pressure monitoring
- Neurosurgery and cardiovascular disease

KEY FEATURES

- Market estimated at more than **\$1.5 billion** by **2026**
- Semiconductor-like manufacturing processes support scaleup to annual volumes of more than **1 million units**
- **1,000-cycle**, ten-year lifespan
- Energy density **10x** higher than similarly-sized commercial products
- **10x** thinner

SCIENCE FOR A BETTER FUTURE

Injectpower offers a level of miniaturization and energy density compatible with the requirements of medical implants.

By enabling custom medical implants for enhanced monitoring of chronic diseases like glaucoma, Injectpower has the capacity to change the lives of millions of patients.

Better eye pressure monitoring can help stabilize glaucoma patients and, ultimately, keep them from losing their vision.

This innovation will provide unprecedented access to a wide range of patient data that will inform the prevention and treatment of disease and improve patients' quality of life.

INTERESTED IN THIS TECHNOLOGY?

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>> WHAT'S NEXT?

Injectpower supplies a highly integrated microbattery to US-based medtech company Injectsense. The battery was developed specifically for iOP-Connect™, an intraocular pressure monitoring device that addresses glaucoma therapy management needs.

Injectpower is now working on stacking microbatteries to augment the energy density of a given surface area.



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