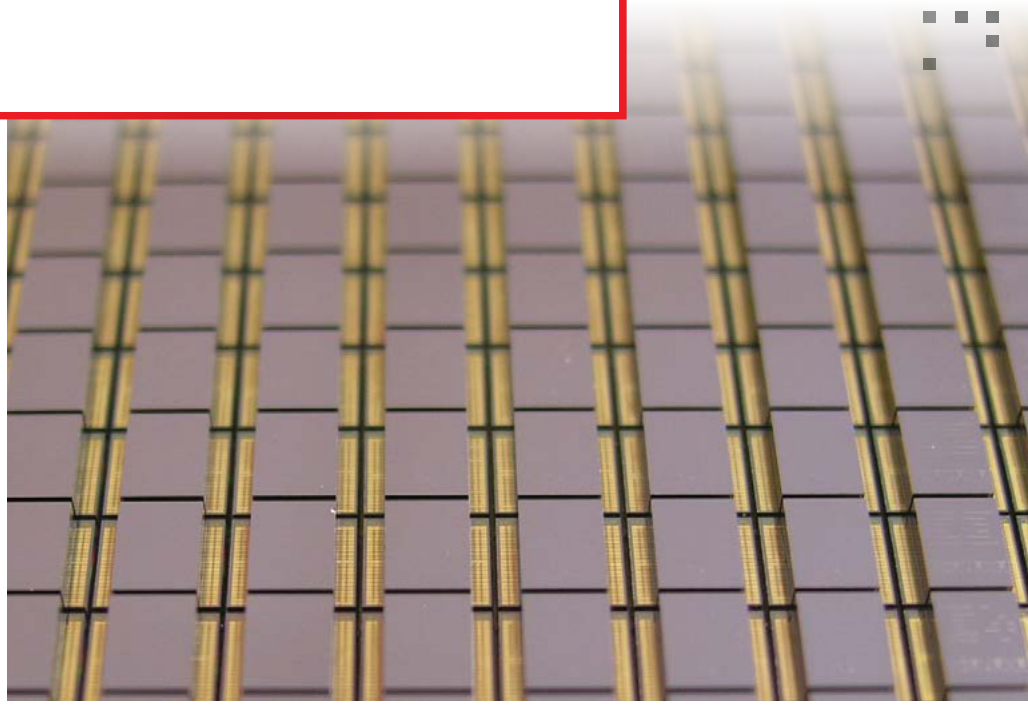
leti
cea tech

SENSORS

A new generation of sensors
for connected objects



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research institute

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Sensors in **the value chain**

When every human activity will be revisited thanks to the opportunity of innovation offered by connectivity solutions, new kinds of sensors, based on miniaturized technologies developed during the last twenty years, will continue to be sources of additional value as they will provide new types of data for new business models. This trend will benefit every new market, from connected cars to digital health to factories of the future.
Whatever business model is chosen, it is key, in order to grab all these new market opportunities, to understand the full value chain around the connected objects, with sensors and related key technologies.

MARKETS

TECH

SENSORS

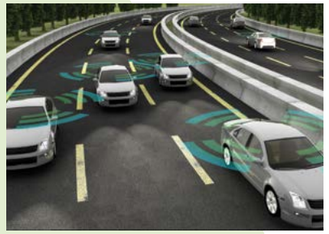
- Transducers
- Signal acquisition
- Data processing

CONNECTED OBJECT

- Sensors
- Data processing
- DataCom
- Energy

SOLUTION

- Connected object
- App
- Network
- IoT platform
- Services



FROM MEASUREMENT TO INFORMATION

KEY TECHNOLOGIES FOR SENSORS AT LETI

LETI'S NEW GENERATIONS OF SENSORS **OPEN UP NEW MARKET OPPORTUNITIES THROUGHOUT THE ENTIRE VALUE CHAIN**

In the era of the Internet of Things and hyperconnectivity, Leti uses its expertise with systems and its cutting-edge technology platforms to propose solutions adapted to each application. Its offer covers both the development of the specific technological building blocks and the complete sensors (sensors that integrate signal processing, communication, and energy management).

TRANSDUCERS & PACKAGING

MATERIAL

- Material integration
- Layer transfer
- Meta materials

MEMS & MOEMS

- 2.5D silicon structures
- Photonics on silicon
- Piezoelectric solutions
- Integrated microfluidics

WLP-SIP

- Wafer bonding
- TSV toolbox

HOUSING

- Hermetic Si packaging
- Integrated getter
- Two-wire packaging

SIGNAL PROCESSING & DATA ANALYSIS

ADC

- Event-driven detection
- Compress sensing
- Analog-to-information converter

DATA PROCESSING

- Very-high-speed multiplexer

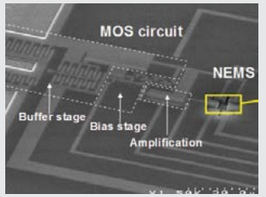
DATA FUSION

- Particle filter
- ULP Bayesian algorithms
- Data crowd sourcing

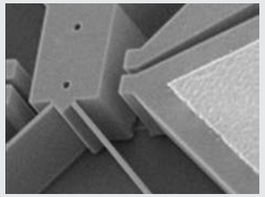
MODELING

- Polymodal sensing
- Database quality assessment
- Algorithms benchmark

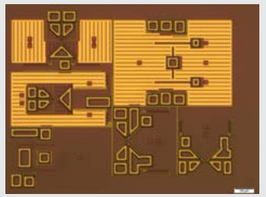
PLATFORMS



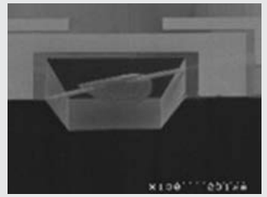
NEMS RESONATOR
- Gas detector
- Spectrometer for biology
- µbolometer
- Cellular force sensor



3D SOI MEMS
- Pressure sensor
- High perf. gyrometer
- cMUT

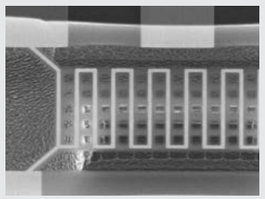


M&NEMS
- Accelerometer / magnetometer
- Gyrometer
- Pressure sensor



OPTICAL SENSING
- ULP NDIR sensor
- QCL on Si

ELECTROCHEMISTRY
- Sweat monitoring
- Ionic sensors



CHROMATOGRAPHY
- µGC, µTCD, concentrator
- Gas analyser
- Liquid analyser

PIEZOMEMS
- pMUT array
- Haptic plate
- Piezoelectric scanner
- Digital loud speaker

FROM SENSORS TO USER FUNCTIONS

LETI'S VISION ON SHORT-RANGE SIMULTANEOUS LOCALIZATION AND MAPPING (SR SLAM), **A KEY FUNCTION FOR TOMORROW'S PROMISING MARKETS**

Leti's technological roadmapping on sensors relies on specific product-oriented roadmaps for each of its platforms. These roadmaps are also the background to propose Leti's user-function vision on some of the most transverse needs that will benefit from multiple sensing solutions and smart data fusion, combining locally up to crowd-sourced measurements.

As an illustration of this approach, the roadmaps on consumer low-cost mechanical combo sensors (up to 11 DOF on the same die) with the M&NEMS platform and on **new ultrasonic sensors** using the piezoMEMS platform are combined with other key solutions to propose Leti's vision for tomorrow's opportunities on low-range SLAM, which is a key function for several of tomorrow's promising markets.

3D ULTRASONIC-SENSOR ROADMAP

available	*on-going*	*3 to 5 years*
Micromachined ultrasonic transducer proof of concept • Capacitive micromachined ultrasonic transducer array grid (medical application)	**2D ultrasonic time-of-flight proof of concept** • 2D piezoresistive micromachined ultrasonic transducer array grid • Electronic phase shifter	**3D ultrasonic sensor** • 2D airborne ultra-low-power ultrasonic time-of-flight sensor • 3D occupation grid

Indoor Smartphone Navigation

Crash-proof Miniature Drone

Robot Companion

Collaborative Driving

AVAILABLE	ON-GOING PROJECTS	3 TO 5 YEARS	5 TO 10 YEARS
INDOOR INERTIAL NAVIGATION • Up to 9 degrees-of-freedom sensor • RF and map matching • Absolute positioning	**LOW-COST TIME OF FLIGHT SR SLAM** • Static time-of-flight IR sensors • 10 degrees-of-freedom inertial measurement unit • Ultra-low-power 3D occupation grid • etc.	**MULTISENSOR LOW-COST SR SLAM** • **3D ultra-low-power ultrasonic imager** • Inertial measurement unit • 3D occupation grid • etc.	**COOPERATIVE SR SLAM** • Multisensor SLAM • Network as sensor

ABOUT LETI

Leti is a technology research institute at CEA Tech and a recognized global leader in miniaturization technologies enabling smart, energy-efficient and secure solutions. Committed to innovation, its teams create differentiating solutions for Leti's industrial partners.

By pioneering new technologies, Leti enables innovative applicative solutions that ensure competitiveness in a wide range of markets. Leti tackles critical, current global issues such as the future of industry, clean and safe energies, health and wellness, safety & security…

Leti's multidisciplinary teams deliver solid micro and nano technologies expertise, leveraging world-class pre-industrialization facilities.

For 50 years, the institute has been building long-term relationships with its industrial partners providing tailor-made solutions and a clear intellectual property policy.

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