L2S, UMR 8506 CNRS

LABORATORY OF SIGNALS AND SYSTEMS

The laboratory of Signals and Systems (L2S) is a joint research unit of the CNRS, CentraleSupélec and the University of Paris-Saclay created in 1974. Research at L2S focuses on fundamental and applied mathematical aspects of control theory, artificial intelligence, data science, information, signal and image processing, communication, and network theory.
The laboratory is organized into three main scientific domains: systems and control, signal processing and statistics, networks and telecommunications. Interdisciplinary themes related to life and health sciences, industry, and energy have an essential place.

Thematic groups

The laboratory is structured in 3 thematic groups:

SIGNALS AND STATISTICS GROUP

focuses on signal and image processing and statistical modeling. Research activities are inspired from data processing challenges in various application fields such as health engineering, nondestructive testing of materials, acoustics, remote sensing, astrophysics, transportation, electrical and mechanical engineering. Our research aims at proposing solutions to big and possibly heterogeneous data analysis, statistical learning, data mining, temporally and spatially correlated signal analysis, optimal design of experiments, and inverse problems in signal and image processing. The proposed methods and algorithms rely on various tools such as multivariate statistics, numerical optimization, random matrix theory, sparse representation, and Bayesian inference. The group is also interested in Algorithm-Architecture Matching issues, at the interface between signal processing and High Performance Computing. This activity aims at fully exploiting the significant potential of parallel computing of signal processing algorithms on GPU and FPGA hardware accelerators.

SYSTEMS AND CONTROL GROUP

deals with fundamental control theory methods and their applications. Its activities are carried out in a broad international context. Among its research interests, one can distinguish the following topics: modeling; estimation, identification and observation; stability, synchronization and robustness; geometric control; predictive and optimal control; optimization, formal methods and artificial intelligence for systems and control; nonlinear, switched and hybrid systems; infinite-dimensional systems (PDEs, systems with time delays...); networked and multi-agent systems; stochastic systems. In parallel, applications are conducted through academic and industrial collaborations. They concern energy systems (smart grids, wind farms, energy conversion, batteries, electric vehicles, etc.); health and life sciences (neurosciences, oncology, bioreactors, artificial respiration, etc.); autonomous systems (robotics, cobotics, drones, autonomous vehicles, etc.); transport (automotive, aeronautics and rail); industry 4.0 and quantum technologies.

TELECOMS AND NETWORKS GROUP

carries out research in the field of wireless mobile and self-organizing networks, from Physical to Application layers. Its main interests are in cross layer design, coding, modeling and performance evaluation, as well as resource allocation. It also has a strong interest in the connection between communication and energy networks. It is making heavy use of such tools as joint source-protocol-channel coding and decoding, robust image and video compression, distributed source coding, game theory, information theory and stochastic geometry.

Projects

The laboratory takes part in various types of projects. These include:

- **13 European projects**: **RIA-ARIADNE** (Artificial Intelligence aided D-Band Network for 5G Long Term Evolution, **RIA-ATHLETE** (The Exposome from Evidence to Translation), **ECSEL-CPS4EU** (Cyber Physical Systems for Europe), **MSCA-MAPNET** (Mathematical Modelling and Optimization of Programmable 5G Networks), **MSCA-META WIRELESS** (Future Wireless Communications Empowered by Reconfigurable Intelligent Meta-Materials), **MSCA-PAINLESS** (Energy-autonomous portable access points for infrastructure-less networks), **MSCA-PATHFINDER** (Harnessing multipath propagation in wireless networks: A meta-surface transformation of wireless networks into smart reconfigurable radio environments), **MSCA-SURFER** (SURface waves in smart Radio Frequency EnviRonments),

ERC-PROCSYS (Towards programmable cyber-physical systems: a symbolic control approach), **MSCA-REALVISION** (Hyperrealistic Imaging Experience), **MSCA-REDESIGN** (distributed, self-adaptable, and scalable wireless fog networks), **ICT-RISE 6G** (Reconfigurable Intelligent Sustainable Environments for 6G Wireless Networks), **5GSmartFact** (Industrial Doctorate Training Network on Future Wireless Connected and Automated Industry enabled by 5G).

- **5 Industrial Chairs: RTE Chair** (Digital transformation of electricity networks), **TCL-Chair on 5G** (Innovative solutions for tomorrow's 5G wireless Digital transformation of electricity networks), **Givaudan Data Science Chair** (Dealing with high-dimensional and multi-scale data in flavours and fragances domains), **APHP-CentraleSupélec-INRIA Chair** (Exploration of frailty related to aging),), **TRANSVALOR** (Intelligence Artificielle pour la Simulation du Forgeage).

- **7 Industrial actions**: **Risegrid Institute** (Research institute for smarter electric grids, coordinated by L2S), **BPI SOFIA** (Solutions for metal additive manufacturing), **OpenLab with PSA** (Electrical engineering for mobility), **BPI AIDA** (Artificial Intelligence For Digital Automation), **BPI SMART V2I** (Étudier, développer et expérimenter un système de vidéo embarquée de qualité suffisante avec métadonnées synchrones associées.), **BPI CPS** (Cyber Physical System), **BPI WIFIP** (SUrface waves in smart Radio Frequency EnviRonments).

- **5 Projects in the frame of "Programmes d'Investissement d'Avenir"**: INSTITUT DATAIA, LABEX DIGICOSME, OI HCODE, ITE "SuperGrid", RHU REVEAL Reshape the EValuation Efficiency and Accuracy of non-small cell Lung cancer.

- **Several ANR Projects:** ALDJAZZ, BWMs, Dark-ERA, ESTHER, HANDY, HEIDIS, IGNITION, MAESTRO 5G, MARGARITA, MindMadeClear, NICEWEET, Q-COAST, ReVeRY, RELOAD, ROCH, RubinVase, SAMOURAI, SMARTinMS, SPATIALX, UMICROWD, ZL-LVC.

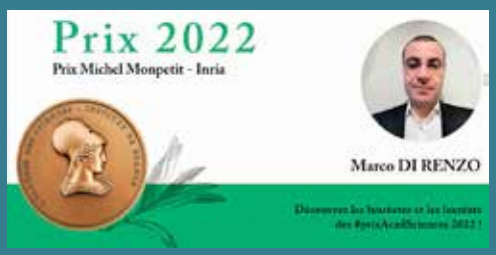
HIGHLIGHTS 2022

Nina Amini received the "Médaille de bronze 2022" of the CNRS, she is also the winner of the "Young Woman Scientist" Irène Joliot-Curie Prize.

Sorin Olaru was general chair of two international conferences co-located at CentraleSupélec in June 2022: IFAC Workshop on Control Applications of Optimization and International Conference on Differences Equations and Applications.

Frédéric Dufaux, EURASIP Meritorious Service Award for his leadership and contributions for the development of visual information processing within EURASIP.

Marco Di Renzo is recipient of the 2022 Michel Monpetit Prize awarded by Académie des sciences (French Academy of Sciences).



Launch of the **UQ@Paris-Saclay Scientific Group:** scientific pole of excellence around the quantification of uncertainties.

SIGNALS AND STATISTICS

The Square Kilometer Array (SKA) radiotelescope in South Africa (left) and Australia (right)- SKAO credit. ANR Dark-era aims to tackle the SKA HPC challenges for the imaging pipeline

SYSTEMS AND CONTROL

Human-robot interaction test bench for co-manipulation control laws validation.

TELECOMS AND NETWORKS

Left : original uncompressed point cloud,
Middle : compressed point cloud using the proposed data-driven geometry compression method based on learned convolutional transforms,
Right : MPEG anchor.

Industrial Partners

- ALCATEL-LUCENT
- ALSTOM
- ATOS Bull
- AVANTIX
- BANG & OLUFSEN
- Boston Scientific
- BRAKES
- BULL
- CEA
- CNES
- DxO
- EDF
- FALGUIERES
- GE MEDICAL
- GIVAUDAN
- HITACHI
- HUAWEI
- IEEE
- IFPEN
- Institut Pasteur
- INTERDIGITAL
- IRCAM
- IRT SYSTEM X
- LNE
- MeilleursAgents
- MICHELIN
- MITSUBISHI
- NOKIA
- ONERA
- OpenLab PSA
- ORANGE
- PICKUP
- PSA
- REGIENOV
- RTE
- SAFRAN
- SHERPA
- SNCF
- SYSNAV
- TCT
- THALES
- TOTAL
- TRANSVALOR
- VALEO
- VEDECOM
- 360LEARNING

Academic Partners

At national level, the laboratory cooperates with most French laboratories of our areas of research.

At international level, the laboratory has 58 partnerships (38 in Europe, 10 in North America, 3 in South America, 2 in Australia, 4 in Asia, 1 in Africa).

Key figures

• Professors, Associate Professors & Researchers	87
• Engineers & Administrative staff	11
• PhD Students	105
• PostDocs	11
• Visiting Professors	14
• Publications of the year (WoS)	327

http://l2s.centralesupelec.fr/

Director: Pascal Bondon

+33 (0)1 69 85 17 12

l2s.direction@listes.centralesupelec.fr

Assistant: Stéphanie Douesnard

+33 (0)1 69 85 17 12

l2s.contact@listes.centralesupelec.fr

CentraleSupélec
Campus Paris-Saclay
Breguet building
3 rue Joliot-Curie
91190 Gif-sur-Yvette