



Une école de l'IMT

LTCI*



LTCI INFORMATION & COMMUNICATIONS LABORATORY

LABORATOIRE TRAITEMENT ET COMMUNICATION DE L'INFORMATION

Computer Science & Networks
Image, Data & Signal
Communications & Electronics

PRESENTATION OF THE LAB

The LTCI* is a laboratory of Télécom ParisTech (Institut Mines-Télécom, IMT). Established in 1982, LTCI is characterized by its broad coverage of the field of information and communication science and technology (ICT). Its research activities range from the hardware layer (electronics, opto-electronics, system on chip, antennae, microwaves...) to the software layer (systems, algorithms, protocols...). They encompass studies on different kinds of data (audio, video, images, semi-structured data and web content) as well as works on network performance and services, or quantum cryptography issues.

The LTCI is composed of 16 research teams spread over 3 research and teaching departments:

COMMUNICATIONS AND ELECTRONICS

This department focuses on the communication and networking tasks with researches that range from the physical layer of information and communication technology (electromagnetism, optical components) to performance evaluation of large-scale communication systems, including works on mixed (analog and digital) signals or safety against physical attacks or digital systems.

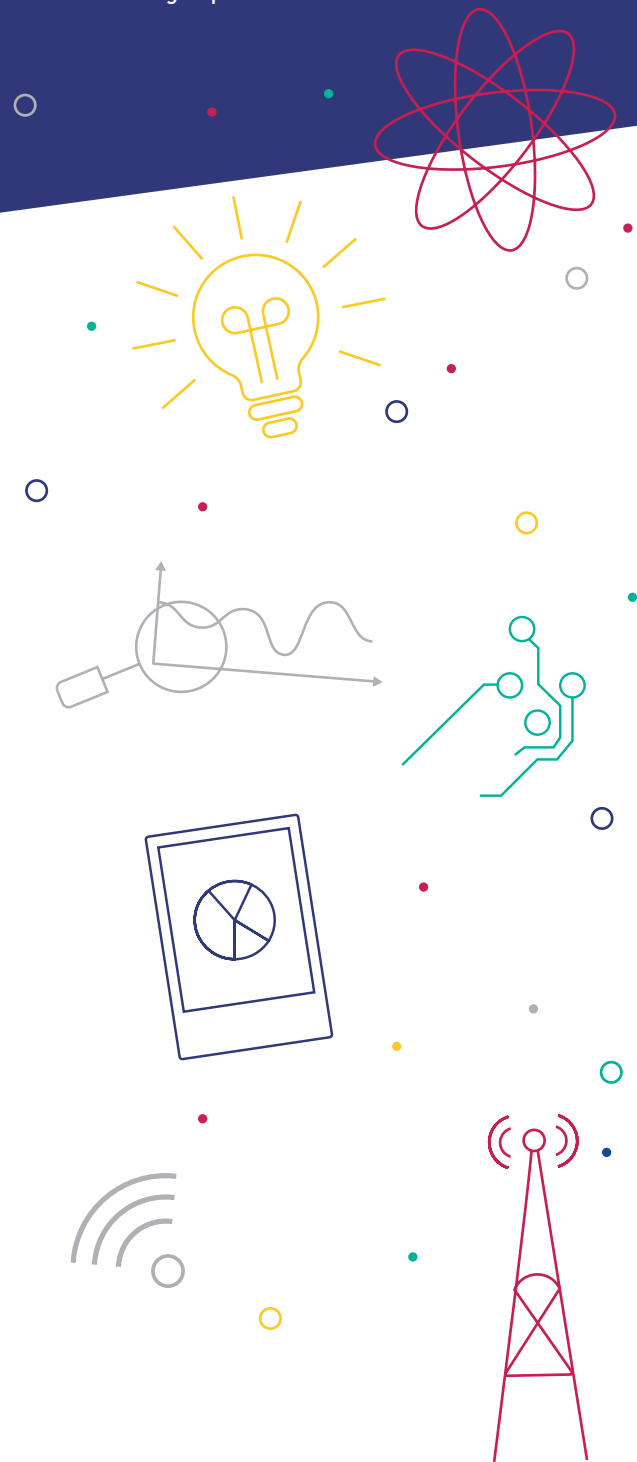
NETWORKS AND COMPUTER SCIENCE

This department focuses on various aspects of computer science (embedded and real-time systems, data management and mining, Human-Computer interaction, cryptography...) with a strong emphasis on networks (performance evaluation, network control and monitoring, design of innovative network services).

IMAGE, DATA AND SIGNAL

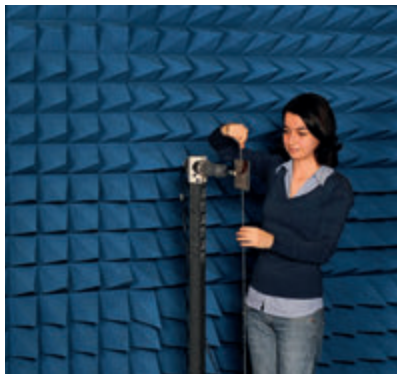
This department covers all aspects of signal and image processing (computer graphics and 3D images, video coding, audio applications, medical imaging, statistical signal processing...) with a specialization in further topics such as emotional in human-agent interactions or statistical learning.

*Formerly UMR 5141 CNRS (until 2016)



SCIENTIFIC PROJECT OF THE LAB

Over the years, the LTCI has contributed to new ideas and techniques in response to the emergence of new challenges raised by the digital transformation and the key societal transitions. The emergence of these challenges, coupled with the unprecedented increase in data volumes, computational capabilities, and access to communication networks is gradually emphasizing the limitations of existing solutions. The scientific project of the LTCI is built around the following five axes:



DIGITAL TRUST: SECURITY, RISK AND RELIABILITY

Security and reliability are studied at Télécom ParisTech at all hierarchical levels of the systems, from the physical layer to the applications via the mathematical tools, the software layers, the network and taking into account the societal aspects.

The major challenge of this axis is the development of tools and methods guaranteeing a high level of reliability and trust, and ensuring the best compromise according to two directions:

- #1** Studying reliability and security in a joint way (horizontal challenge), i.e. modeling and managing synergies and conflicts between these two issues;
- #2** Integrating the protection/reaction mechanisms at all the hierarchical layers (vertical challenge), from the physical layer to the applications via the mathematical models, the software issues, the networks, and the societal impact.

DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

In this axis, we focus on the theoretical foundations of the management and analysis of data in all its forms (massive, complex, heterogeneous, uncertain, etc.) and their concrete applications in domains of major interest such as health, well-being and cybersecurity. This axis relies on the expertise of our teams in statistics, mathematics and computer science, and on expertise on the various types of data (images, video, sound...). A close collaboration with the Department of Social Sciences and Economics of Télécom ParisTech allows extending our action towards end-users. This axis mobilizes different teams and creates a multidisciplinary exchange framework open to the socio-economic world around issues such as image processing, predictive analysis, recommendation systems, anomaly detection, web mining, social networks analysis, scalability or knowledge management.

The two main challenges of this axis are:

- #1** Scalability of the solutions, control of their complexity and the explainability of the algorithms;
- #2** Leverage of the multidisciplinary dimension-combining methods, technologies and uses.



VERY LARGE NETWORKS & SYSTEMS

The research interests in this axis lie in the design and study of future emerging networking technologies, whether it is for mobile networks, wireless networks, optical networks, the Future Internet, etc. The LTCI has skills covering all of the research areas in this domain; it designs the systems and infrastructures of tomorrow, that should be global, integrated, agile, and sustainable.

The two main challenges of this axis are:

- #1** Scalability of the systems, i.e. a continuous but tenable increase in the capacities of transmission (optical, radio...), communication, storage, and processing, in the number and diversity of objects to connect, contents and users;
- #2** New architectural paradigms, global, integrated and distributed, agile and programmable, intelligent and self-organized, leading to the emergence of unpredictable behavior.

MATHEMATICAL MODELING

This axis is transverse to the first previous ones, in the sense that it contributes to each of these axes and is one of the strengths of the laboratory which is interested at the same time in the theoretical and practical aspects of research in ICT. It can be divided into three parts: Content, Knowledge and Interactions Modeling; Networks and Systems Modeling; and Information (and its ecosystems) Modeling.

The two main challenges of this axis are:

- #1** The compromise between fidelity to the real world and the efficiency of the models (usability, computability, adequacy to needs);
- #2** The ability to address problems with a high level of complexity, involving heterogeneous, possibly massive or incomplete data, involving poorly controlled uncertainties or needs for unbounded calculation resources.

DESIGN, INTERACTION & PERCEPTION

Here the main objectives are: to design digital and semantic models of the physical, social, emotional reality from multimodal data perceived in complex environments ("in the wild"); to build new forms and languages for interaction between humans and systems; and to exploit these models for the design of objects, worlds and experiences.

The two main challenges of this axis are:

- #1** Processing information that allows the machine to take full advantage of the multiple sources and computing capabilities;
- #2** Designing effective, expressive, and evolving interactions and devices for environments with a multiplicity of data, artifacts and humans.



The objective of the Lab is to develop a research activity at the highest level and to contribute to the innovation effort and transfer to the industry.

KEY FIGURES

Overall, the permanent staff of the LTCI consists of 118 professors from Télécom ParisTech (62 of them being associate professors and 56 full professors), 15 engineers and technicians and 10 people in the administrative staffs working primarily in the service of research.

Mid-2018, the non-permanent staff counted 21 postdocs and 188 PhD students, including 53 CIFRE (Convention industrielle de formation par la recherche) who are employees of industrial partners of the lab, and 3 PhDs in co-supervision, that is they are jointly supervised by members of the lab and foreign academic partners. The lab also benefits from the presence of 10 invited professors and associated researchers and 10 emeritus professors who are actively contributing to our research.

SIGNAL PROCESSING ANTENNAE
DATA SCIENCE COMPUTER GRAPHICS
MOBILITY INFORMATION GRAPH-MINING
MACHINE LEARNING CYBERSECURITY QUANTUM INFORMATION SYSTEM ON CHIP CODING
ELECTRONICS OPTICAL COMMUNICATIONS GRAPH THEORY RANKING SYSTEMS
STATISTICS COMMUNICATIONS ALGORITHMS
MODELING PROBABILITIES HUMAN-COMPUTER INTERACTION

PRODUCTION AND RESEARCH ACTIVITIES

2013
2018



4 ERC GRANTS



500+

publications per year
(journals, conference
proceedings and books)
> 4.23/researcher/year



10 MILLION €

turnover in
partnership research
> 85K€/researcher/year

ECOSYSTEM

PARIS-SACLAY

The ecosystem of the LTCI is now mainly organized around Télécom ParisTech, Paris-Saclay (Université Paris-Saclay and, since October 2018, the new project around Ecole Polytechnique), structuring the research activity in Paris-Saclay. Télécom ParisTech and the IMT are strongly involved in the Paris-Saclay project, which aims to become a world-class campus by gathering several higher education institutions physically located in the south-west of Paris. The campus is not limited to research and education centers as several major French companies (including, among others, Thales, EDF, and Danone) already settled part of their research activities on the campus.

Télécom ParisTech is one of the founding members of a new project gathering five Grandes Ecoles (Ecole Polytechnique, ENSTA ParisTech, ENSAE ParisTech, Télécom ParisTech and Télécom SudParis) and HEC as a privileged partner, and which aims to create a world-class Institute of Science and Technology.

The scientific project of the LTCI is consistent with the priorities of this Institute, since three axes are among its main priorities (Cybersecurity, AI and Data Science, Networks and IoT). The LTCI is one of this Institute's main laboratories in the field of Information and Communications Technology (ICT), in terms of size and scientific production.



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THE CARNOT LABEL

Télécom ParisTech is one of the components of the Télécom & Société numérique Carnot (TSN), the premier Carnot in a network of 29 dedicated to the information and communication science and technology. The TSN center brings together more than 20 joint laboratories – including the LTCI – totaling over 2,000 researchers and doctoral students, in order to offer cutting-edge research and integrated solutions for issues linked to the information and communication technology.

LTCI has been granted the Carnot Label. The label was created in 2006 to support partnership-based research, in other words to promote research projects undertaken by both public research players and those from the socio-economic world. This label takes the form of financial support from the French National Research Agency (ANR) to the labeled lab or institution, calculated on the basis of the income generated by partnership-based research contracts, with companies especially. The Carnot network mission is for scientific excellence to serve corporate innovation.