

# Mechanical & Industrial Engineering

Sorbonne University has a complete range of mechanical engineering research, with pluridisciplinary teams from UPMC and UTC.\*



## The Jean Le Rond d'Alembert Institute

The d'Alembert Institute works to extend the scope of knowledge in all areas of mechanics, acoustics and energy. It is co-supervised by UPMC and the CNRS, and supported by the Ministry of Culture. It is the largest lab in this specialty in the Paris region. It has a staff of nearly 170, of which approximately 50 are doctoral candidates.

D'Alembert has expertise in two areas: the theory and fine modeling of fluid and solid mechanics; and the study of the musical object in a multidisciplinary approach using physical and human sciences. D'Alembert researchers rank first in the world in the field of fracture mechanics, direct numerical simulation of two-phase flows, the study of slender structures, and the simulation of large turbulent structures (Large Eddy Simulation or LES) of non-linear acoustic propagation and sonic boom.

New themes emerge through cross-collaboration, such as aero-acoustics (sound generation by turbulence) or dynamic elasto-capillarity (winding elastic solid structures around liquid droplets). Moreover, d'Alembert has facilities for large-scale experimental investigations supported by industrial and public partnerships

in the field of combustion engines, pollutant removal, seismic and long-range Earth imaging and acoustic imaging.

D'Alembert is structured into five teams:

- Complex Fluids and Hydrodynamic Instabilities
- Reactive Fluids and Turbulence
- Lutherie - Acoustics - Music
- Mechanics & Engineering of Solids & Structures
- Modeling, Propagation and Acoustic Imaging

## The Science & Technology of Music & Sound Laboratory (STMS)

The STMS lab, hosted at IRCAM in the center of Paris, is the largest facility in the world for research in music and sound connected to artistic creation. It has more than 100 staff including 30 doctoral candidates and is co-supervised by IRCAM/Ministry of Culture, the CNRS and UPMC. STMS is associated with the CNRS Institute of Computer Science and integrated in the UPMC Engineering Faculty.

The lab has seven teams:

The **Instrumental Acoustics** team studies the functioning of musical instruments. It develops models based on physics that take into account the production characteristics and sound radiation.

The **Acoustic and Cognitive Spaces** team is dedicated to sound field reproduction in its spatial and cognitive dimensions. It uses signal processing for sound field modeling and software engineering for the design of spatial control interfaces.

The **Sound Perception and Design** team studies the description and meaning of sounds and the identification of sound sources and the perception of sound sequences.

The **Analysis & Synthesis of Sounds** team conducts research on the analysis, synthesis and transformation of sounds using signal processing methods or acoustic modeling of sound sources.

The **Musical Representation** team is interested in modeling musical structures and processes through the development of high-level programming languages and architectures. It enables the processing of symbolic musical structures using graphic and reactive programming languages.

The Analysis of Musical Practices team studies the scholarly works and musical practices of the 20<sup>th</sup> and 21<sup>st</sup> centuries from the perspective of musicology and humanities.

The Interactions for Sound, Music and Movement team develops new paradigms for realtime interaction between humans and music computing systems.

### Francilienne Federation of Mechanics

The Francilienne Federation of Mechanics gathers almost all the public laboratories on the mechanics of solids and structures in the greater Paris area. This represents approximately 400 scientists and engineers, and as many doctoral candidates. This research structure “without walls” was created in 2003 by the CNRS and is supported by the Minister of Higher Education and Research.

The Federation works to:

- Promote the development of new scientific methods to better manage the entire materials-structures-processes chain. This requires specialized multidisciplinary synergies between teams and the development of multi-scale approaches to connect the different levels of analysis, from the atom to industrial unit
- Implement a shared equipment policy by establishing experimental and high-performance computing platforms that are shared and open to external partners. This will strengthen the coherence of mechanical research in the Paris region, and improve and promote research and higher education through partnerships within Federation institutions.

As a center of expertise open to external collaboration, the Federation is involved in various research activities, such as internships and theses in co-management; hosting foreign scientists and collaborative studies within the framework of national and European projects; and defining and implementing federative projects that are supported by the Île-de-France region.

Jean Le Rond d'Alembert Institute: [www.dalembert.upmc.fr](http://www.dalembert.upmc.fr) – STMS: [www.ircam.fr/stms.html](http://www.ircam.fr/stms.html) – Francilienne Federation of Mechanics: [www.f2m.cnrs-bellevue.fr](http://www.f2m.cnrs-bellevue.fr) – Roberval: [www.roberval.utc.fr](http://www.roberval.utc.fr)

### Mechanical and Acoustic Materials (Roberval)

The Roberval laboratory brings together professor-researchers, technical staff and doctoral candidates from UTC to research the fields of material science, solid and fluid mechanics, and acoustics and vibrations. The lab has a systematically interdisciplinary approach on shared platforms and through the development of group projects that draw on the expertise of each.

Roberval has three divisions:

**Numerical Methods in Mechanics** focuses on techniques to correlate trials through robust calculations. They develop specific and original computational methods and models to solve and optimize complex multi-physics problems on large industrial systems to increase performance and control the important parameters.

**Acoustics and Vibrations** develops and implements numerical models and experimental tools to optimize the vibroacoustic behavior of structures for better acoustic comfort. This includes studying the propagation of guided aeroacoustics, the radiation from vibrating structures, the optimization of acoustic materials, and the identification and modeling of acoustic sources. This team works closely with automotive and new material companies.

**Materials and Surfaces** analyzes the behavior of metals and multi-materials, and more specifically focuses on the characterization of surfaces and interfaces. Their work is oriented toward mechanics and takes into account the environment. The team is divided into two areas: mechanics and morphology of surface and interfaces; and the mechanics and mechanisms of degradation.

Roberval is part of the CNRS Institute of Engineering Sciences and Systems. The lab provides training for more than 40 percent of the engineering students that graduate from UTC, as well as the Mechanics and Systems Master's.