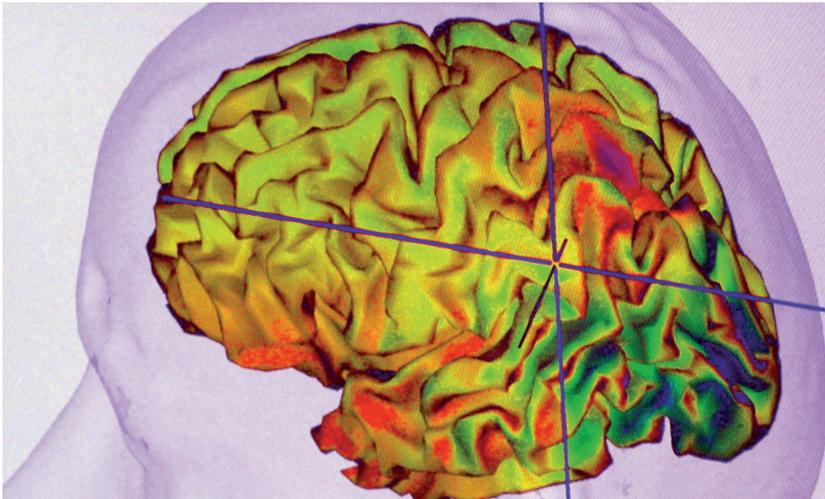


Modeling & Simulation

Sorbonne University is actively looking to boost innovation through combined expertise from different disciplines.

Modeling and simulation research laboratories offer exceptional synergies when combined with other domains.



The ICS

The Institute for Scientific Computing and Simulation (ICS) is a center of research, expertise and training in scientific computing, operating a wide range of allocated computational resources and high-performance 3D visualization devices. The Institute enables multidisciplinary teams to work on collaborative projects in scientific computing. It stimulates, supports and promotes the development of innovative computational methods to allow the multidisciplinary teams to achieve significant scientific breakthroughs.

The Institute has three components:

- A scientific computing center for shared research
- A training/learning center for the dissemination of good practices in scientific computing
- A service and support unit dedicated to software administration of computational resources at UPMC*

Scientific Visualization

The French *Investing for the Future* program and the Île-de-France Region awarded funding to ICS for a Scientific Visualization Facility (RefICS project). The Visualization Wall is a new high-resolution stereoscopic and interactive display for use by researchers, engineers and students.

Mathematical & Computer Modeling of Complex Systems (UMMISCO)

The UMMISCO, under the joint supervision of IRD* and UPMC*, has partner teams in France, Africa and Southeast Asia. The thematic applications in modeling research conducted in this laboratory are linked to the major scientific priorities of the IRD. Sciences of complexity are undergoing rapid development, motivated by global issues (such as ecology, public health, social stability). UMMISCO's major challenge is to model these complex systems, whose behavior at a given scale is the product of interactions between a large number of entities at a smaller scale.

The Biomedical Imaging Laboratory (LIB)

LIB specializes in fundamental research and applications of biomedical imaging methods for morphologic, functional and molecular exploration of small animals and humans. The main areas of investigation are 21st century public-health priorities: bones, cancer, and cardiovascular and neurological diseases. They develop new non-invasive diagnosis and treatment methods, using ultrasound, MRI, CT and SPECT-PET.

The LIB has four teams:

- Determinants of bone mechanical status
- Imaging & Therapy Development: nanostructures to humans, applied to cancer management
- Cardiovascular Imaging
- Anatomic-functional Dynamical Systems in Humans, alteration and functional recovery

Its fields include applied mathematics, computer science, biomechanics, acoustics, instrumentation and medical engineering, nanotechnology, biophysics, signal and image processing, cognitive neuroscience, neuropsychology, neurodynamics, physiopathology, diagnosis and therapy. Methodological developments include new instrumentation, specific tools for image processing, modeling and simulation, as well as the conception of new nanotechnology-based drug-delivery strategies.

* IRD: French National Research Institute for Development
UPMC: Pierre and Marie Curie University

LABEX

Computational Biology & Chemistry

CalSimLab, proposed by the ICS, was awarded “Laboratory of Excellence” by the French government’s *Investing for the Future* program. CalSimLab is building a coherent theoretical background to develop adapted numerical methods and implement efficient algorithms for: Linear Scaling in Computational Chemistry; Molecule Energy Approximation in Computational Chemistry; Sequential Algorithms in Computational Biology; and Algorithms for Genomics.

The Compiègne Laboratory of Applied Mathematics (LMAC)

The LMAC at UTC* is a transdisciplinary lab researching applied mathematics through numerical analysis and optimization; and probability, stochastic processes and statistics. LMAC has two themes: inverse problems and stochastic systems. The lab works with the medical community, industry and research centers.

LMAC’s research has applications in:

- The detection of sources in EEG-MEG
- The detection of pollution sources
- Blind Source Separation
- The ability to identify dynamic systems
- The statistical treatment of incomplete data with application in reliability and survival analysis
- The analysis of DNA sequences through hidden semi-Markov models
- The impact of static-magnetic fields (MRI) on ECGs
- Inference for seismology data
- Performance and stability of complex systems
- Bayesian modeling of genetic networks in biology

COMBINING MATHEMATICS & MEDICINE

The Jacques-Louis Lions Laboratory and the Probability and Random Processes Laboratory have developed research activities in modeling and high-performance computations applied to life sciences. These include evolution and ecology, algorithms for genetics, neurosciences and developmental biology, molecular networks, tissues and cicatrisation, and medical applications such as tumor growth. Their partners are the CIRB (Interdisciplinary Centre for Biological Research) at the Collège de France, Inra* and several joint Inria* teams.

MAMBA: joint INRIA/UPMC research

MAMBA has researchers in applied mathematics, computer science, statistical physics and medicine. They study application domains related to biology and medicine. The team is also optimizing

cancer pharmaco-therapeutics from a molecular-systems biology perspective. Studies on cancer modeling and therapy are conducted with UPMC’s University Institute of Oncology.

Research topics of the MAMBA project include partial and ordinary differential equations, methods of statistical physics, numerical algorithms and applications for:

- Cell division cycle modeling for healthy and cancer cells
- Aggregation-fragmentation models for prion and Alzheimer’s diseases
- Cell chemotaxis and cell aggregation
- Molecular cancer pharmacotherapy and its optimization
- Individual-based models of tissue and tumor growth

REO: joint INRIA/UPMC research

The REO project team is working on the modeling, analysis and numerical simulation of biological flows. It develops high-performance software for life sciences. Its main objectives are to:

- Model blood flows in large vessels and air flows in the respiratory tract
- Design and analyze efficient and robust numerical methods for such flows
- Develop numerical software to assist in making medical decisions and to improve existing medical devices

REO’s research themes cover direct and inverse modeling and computational methods for:

- Fluid-structure interaction problems: interaction blood/arteries or cardiac valves
- Cardiac electrophysiology & electro-mechanical coupling
- Aerosol deposition in the respiratory tract

* UTC: Compiègne University of Technology
Inra: French National Research Institute of Agronomy
Inria: French National Research Institute on IT and Automation

ICS: www.ics.upmc.fr — UMMISCO: www.ummisco.ird.fr — LIB: www.lib.upmc.fr — LMAC: www.lmac.utc.fr — MAMBA: www.inria.fr/equipes/mamba — REO: www.inria.fr/equipes/reo