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With a scientific task force of more than 3500 researchers and an annual research budget of 125 M€, the research is a true driving force behind UCL's activities. Through European, national and regional research programs, particularly in the aeronautics and space areas, UCL continuously contributes to the advances in a variety of research topics:

- Composites & Engineering materials
- Multi-physics & multi-scale modeling
- Thermodynamics & fluid mechanics
- Mechatronics
- Information & Communication Technologies
- Research platforms: fabrication, characterization & testing facilities directly accessible for companies

Both fundamental and applied researches are carried out with the technical support of research platforms and experimental laboratories.

## Composites & Engineering materials

The Research center on ARChitected and COMposite MATerials federates the activities of several teams working in the field of architected, hybrids and composite materials: the Engineering and Rheology of Composites and Macromolecules (IMCN/ERC&M) and the Materials and process engineering (iMMC/IMAP) research groups. ARCOMAT gathers expertises on (in)organic materials, on experimental characterization and multi-scale/physics modeling, and on mechanical and functional properties. Researches are articulated around the development of innovative composite or architected material solutions through processing, characterization, testing, assembling, modeling and selection of engineering materials. ARCOMAT also offers an integrated support to the industries working in the field of composites.

**More information:** [uclouvain.be/en/research-institutes/imcn/bsma](http://uclouvain.be/en/research-institutes/imcn/bsma)  
[uclouvain.be/en/research-institutes/immc/imap](http://uclouvain.be/en/research-institutes/immc/imap)

## Multi-physics & multi-scale modeling

The MEchanics MATHematics division (iMMC/MEMA) has two main activities in the field of aeronautics. Firstly, based on multiscale modeling schemes, MEMA develops constitutive laws for advanced materials used in aeronautics. Nonlinear mean-field approaches accounting for different types of reinforcements (particles, short, long fibers or foams) as encountered in polymer-based composites and in metal-matrix composites. Novel crystal plasticity models are developed in order to investigate forming of multiphase metallic alloys. Secondly, based on home-made numerical codes, MEMA performs intensive finite element simulations of multi-physics processes. Its expertise is in adaptive meshing, parallel computing, unit cell calculation of materials with intricate microstructures, and robust integration algorithms in fluid mechanics.

**More information:**

[uclouvain.be/fr/instituts-recherche/immc/mema](http://uclouvain.be/fr/instituts-recherche/immc/mema)

## Thermodynamics & fluid mechanics

The research at the division of thermodynamics and fluid mechanics (iMMC/TFL) in the field of aeronautics covers three main topics: [1] fluid mechanics, aerodynamics and hydrodynamics: external flows past streamlined and bluffbodies, aircraft wake vortex flows, shear flows, internal flows, reacting flows, advanced numerical methods, advanced turbulence modeling; [2] energy systems and combustion: thermodynamics, thermal cycles, heat transfer, analysis of processes, combustion equipments, thermal engines; [3] two-phase flows: particle-laden flows, critical flows, ejector flows, atomization, nucleation. The research benefits from the technical support of the HPC facilities of UCL.

**More information:** [uclouvain.be/en/research-institutes/immc/tfl](http://uclouvain.be/en/research-institutes/immc/tfl)

## Mechatronics

The Center for Research in Mechatronics (iMMC/CEREM) focuses on the design, modeling, simulation, optimization and prototyping of mechatronic systems, i.e. systems optimally integrating sensors, actuators and control strategies within mechanical devices. More specifically, the CEREM develops five axes of research and expertise: Multibody and multi-physics modeling; Optimal design of mechatronic devices; High Performance Actuators; Power electronics; Innovative joining process.

**More information:** [www.cerem.be](http://www.cerem.be)

## Information & Communication Technologies

The Institute of Information and Communication Technologies, Electronics and Applied Mathematics (ICTEAM) carries both basic and applied world-class research in various sub domains with direct applications in the aeronautical sector: Communication systems and networks (positioning, channel modeling, navigation systems...); Cryptography and Information Security (strong security protocols design & analysis); Dynamical Systems, Control and Optimization; Electronic Circuits and Systems (embedded systems, ultra low power for harsh environments, radiation hardness, sensors); Micro and Nano Technologies and Systems (characterization of material properties at the nanoscale, composite materials for EM shielding); Microwave Engineering and Applied Electromagnetism (numerical electromagnetics, RF & microwave circuits, antenna design, satellite communications); Signal and Image Processing.

**More information:** [uclouvain.be/en/research-institutes/icteam](http://uclouvain.be/en/research-institutes/icteam)

## Research platforms

The Wallonia Electronics and Communications Measurements platform (WELCOME) proposes a wide panel of **characterization** techniques under various electromagnetic, mechanical and temperature conditions that are of prime interest for automotive, space, aeronautics and radar applications. Tools and expertise result from key research axes including micro- and nanotechnology, SOI technology, RF circuits and antennas, digital systems and VLSI architectures, cryptography, MEMS/NEMS, ultra low-power circuits, extreme-environment components (radiations, temperature) and wireless communications.

**More information:** [sites.uclouvain.be/welcome](http://sites.uclouvain.be/welcome)

The Wallonia Infrastructure Nano Fabrication facility (WINFAB) is a shared resource serving academic and industrial researcher. Main activities include the **fabrication** of SOI-CMOS integrated circuit processing, MEMS/NEMS, nanoelectronics, organic electronics, photovoltaics and sensors. WINFAB supports a broad line of lithography, thin-film deposition, reactive ion etching, and characterization tools in support of device fabrication for a variety of materials.

**More information:** [sites.uclouvain.be/winfab/NEW\\_website/login.html](http://sites.uclouvain.be/winfab/NEW_website/login.html)

The Laboratory of mechanical **testing**, structures and civil engineering (iMMC/LEMSC) provides, in the field of aeronautics, an integrated research platform for mechanical testing of materials, especially composites, and structures, under ISO 17025 certification.

