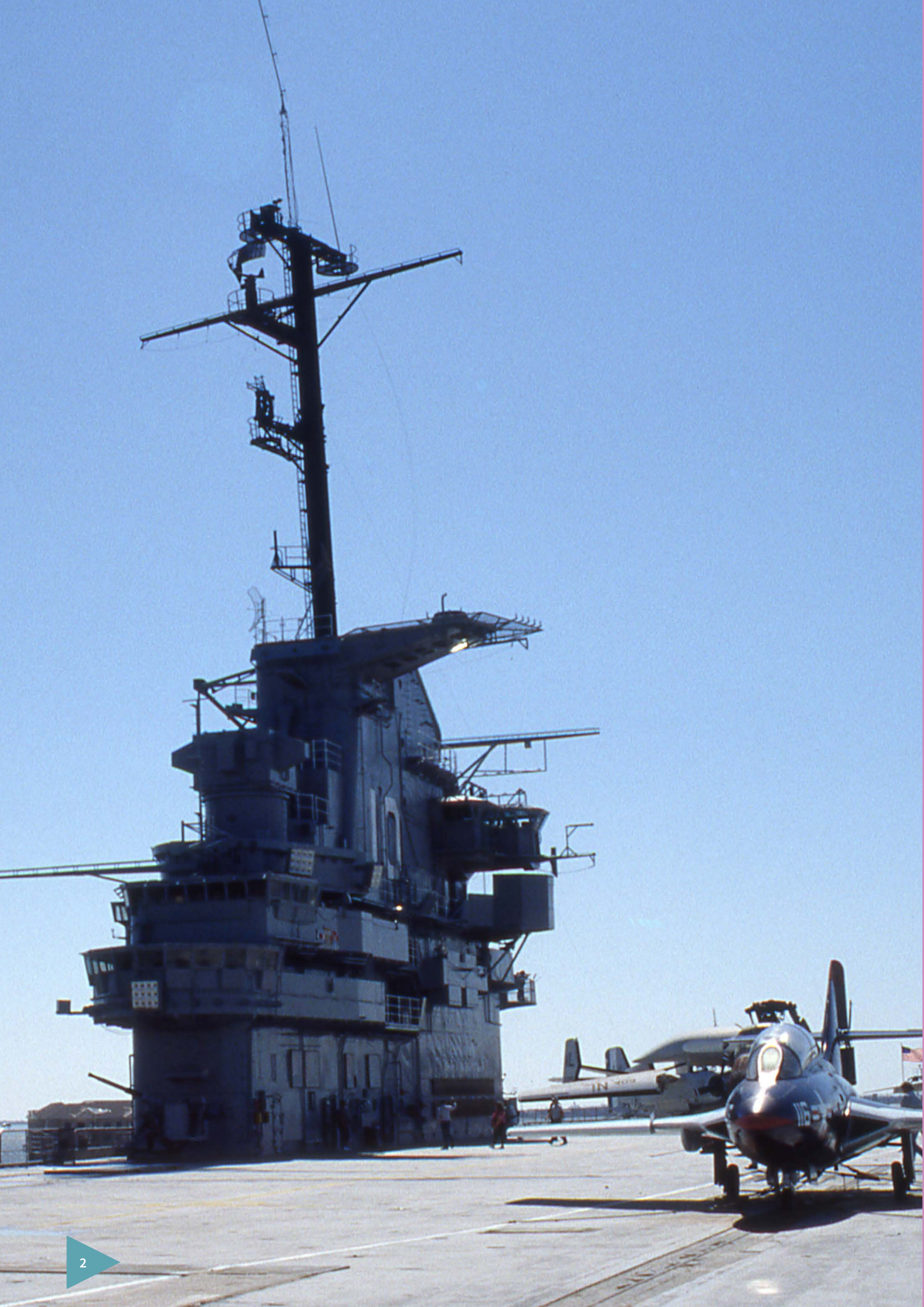
Université de Liège

The competencies of the University of Liège for the Key Enabling Technological Defense and Security Applications (KETA)

LIÈGE université
Interface Entreprises
Recherche & Innovation



INTRODUCTION

L'Université de Liège (ULiège) regroupe plus de 3 300 chercheurs, scientifiques et techniciens, et donc autant de compétences pointues en sciences et techniques, sciences humaines et sociales et en sciences du vivant.

Depuis toujours, l'ULiège prône un décloisonnement entre le monde universitaire et le monde économique, décloisonnement indispensable à la croissance économique par l'innovation. Favorisant cette proximité, l'Interface joue ainsi un rôle-clé dans la mission de service à la Société de l'ULiège, qu'elle remplit en connectant recherche universitaire et besoins des entreprises innovantes et en accompagnant leurs collaborations dans tous les domaines de compétences de l'Université. Elle permet donc aux entreprises un accès facilité aux compétences, formations et équipements de pointe de l'ULiège.

Particulièrement dans le cadre des Intérêts Essentiels de Sécurité (IES) et plus spécifiquement pour les applications technologiques essentielles de soutien aux IES belges, l'ULiège a développé des compétences variées et pointues qu'elle rend accessible par :

- Les formations de type Master telles que les Masters Aérospatiale, Chimie et Sciences des matériaux ou encore Spatial. Autant d'ingénieurs formés et opérationnels prêts à intégrer les entreprises du secteur dans le cadre de stages ou de premières embauches ;
- La mise à disposition d'équipements et d'infrastructures de pointe tels que la Soufflerie pluridisciplinaire, le laboratoire de test mécanique des matériaux et de structures, les installations d'essai du Centre Spatial de Liège, les salles blanches, etc. ;
- La création d'entreprises spin-off, dont plusieurs d'entre elles sont leaders dans leur secteur : Amos, Samtech, Open-Engineering, etc.

Cette brochure donne un aperçu non exhaustif des compétences de l'ULiège sélectionnées selon les 5 *Key Enabling Technological Defence and Security Applications* :

1. Systèmes et sous-systèmes pour des applications de défense et de sécurité
2. Capteurs et traitement de données pour des systèmes de Commande, Contrôle, Communications, Computers and Intelligence (C4I)
3. Matériaux et composants de pointe
4. Systèmes d'entraînement et de simulation
5. Protection des systèmes d'information

Dans une vision à plus long terme, nous proposons également des compétences en technologies quantiques qui seront reprises sous un 6e axe.

Pour l'Interface Entreprises de l'Université de Liège,

Dr. Ir. Olivier Gillieaux
Technology Transfer Officer, Science & Technology

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THE KETA AXES

5 KETA axes

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ULIÈGE'S DEPARTMENTS

A&M RESEARCH UNIT

AEROELASTICITY AND EXPERIMENTAL AERODYNAMICS (AEA)

The AEA carries out internationally recognized research in the fields of aeroelasticity, experimental aerodynamics and fluid-structure interaction. Applications include air vehicles, civil engineering structures and land vehicles. The research group collaborates closely with the University's large, closed return multidisciplinary low speed wind tunnel. It has two working sections, with a maximum cross-sectional area of 2.5x1.8m (width x height) and a maximum airspeed of 60m/s.

www.ltas-aea.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

TRAINING AND SIMULATION SYSTEMS

COMPUTATIONAL & MULTI-SCALE MECHANICS OF MATERIALS (CM3)

The CM3 focuses on the developments of multi-scale numerical methods for complex non-linear engineered materials, such as the failure study of composites, foamed materials, and MEMS. The research is achieved through international collaborations with other universities, research centers, and industries; it is financed through national and European projects.

www.ltas-cm3.ulg.ac.be

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

ADVANCED MATERIALS AND COMPONENTS

METALLIC & MATERIALS SCIENCE UNIT (MMS)

The MMS studies the physico-chemical phenomena that governs optimization of metallic materials and determines their properties.

The main focus is concerning thermal treatments, phase transformations at liquid and solid state for aeronautical alloys (Al, Ni, Ti, special steels) and thermophysical properties.

The MMS researches concerns also microstructure obtained through particular processes such as: thixoforming, vacuum coating and deposition of thin foils, friction stir processing, laser cladding, electron beam melting, powder metallurgy.

www.metaux.ulg.ac.be

ADVANCED MATERIALS AND COMPONENTS

COMPUTER AIDED GEOMETRIC DESIGN GROUP

The Computer Aided Geometrical Design group is active in research in CAD/CAM/CAE and the link with novel numerical simulation techniques. Among our research topics, the following have applications in aeronautics:

- Novel simulation techniques like the Extended Finite Element Method (X-FEM)
- Application of the X-FEM to the simulation of composite structures (structural analysis or manufacturing techniques)
- Structural analysis-driven automatic model simplification
- Mesh Generation for numerical simulations

www.cgeo.ulg.ac.be

ADVANCED MATERIALS AND COMPONENTS

TRAINING AND SIMULATION SYSTEMS

NON LINEAR COMPUTATIONAL MECHANICS

Computational Mechanics specializes in tailored software developments and numerical simulation of problems involving large deformations, complex contact situations and multi-physics couplings. Our finite element based software METAFOR can deal with complex material behaviors including damage and fracture propagation for both metallic and composite materials. Domains of application are:

- Impact simulation and crashworthiness
- Hot and cold metal forming processes
- Tire mechanics & rubber.
- Biomechanics

These numerical models result from many collaborative projects with industry. These projects are funded by the European Community, the Walloon Region and the Marshall Plan.

metafor.ltas.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

ADVANCED MATERIALS AND COMPONENTS

TRAINING AND SIMULATION SYSTEMS

MECHANICAL VIBRATIONS LAB (LTAS-VIS)

The field of expertise of the LTAS-VIS research group relies in the theorical and experimental dynamic analysis of jet engine mechanical components. The main topics on which LTAS-VIS has developed a strong research expertise are the following:

- Structural design of aircraft engines
- Turbomachinery rotordynamics
- Vibration testing and modal analysis

Research developments are performed with the aim of implementation in industrial finite element programs such as Samcef and/or Oofelie. Experimental activities are closely related to the setting-up of vibration testing facilities.

www.ltas-vis.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

TRAINING AND SIMULATION SYSTEMS

MULTIBODY & MECHATRONIC SYSTEMS LABORATORY

The main research activities are simulation methods for the analysis of complex dynamic systems, with a particular focus on the kinematic and dynamic analysis of mechanical systems, advanced numerical solvers, model order reduction techniques, optimization methods, motion and vibration control, mechatronics, multiphysics systems, biomechanics and human motion analysis.

The Multibody & Mechatronic Systems Laboratory develops computer-aided tools for the mechanical and control design of deployable space structures, large telescopes, robots, machine tools, wind turbines, vehicle suspensions, powertrains. The team is also involved in the Laboratory of Human Motion Analysis of the University of Liège.

www.ltas-mms.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

MULTIPHYSICS AND TURBULENT FLOW COMPUTATION (MTFC)

MTFC is specialized in computations of turbulent flows and complex multiphysics covering a broad range of applications in aerospace and other fields. The MTFC research group focuses on the development of robust and efficient numerical tools, and large-scale simulations at different levels of fidelity (DNS, LES, DES, RANS) to better understand the physics and to develop predictive models in order to optimize engineering systems. The interest area of the research group is very broad with applications like supersonic combustion for scramjets, steady and unsteady aerodynamics, fluid-structure interaction and aeroelasticity, heat transfer, etc.

www.mtfc.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

ADVANCED MATERIALS AND COMPONENTS

TRAINING AND SIMULATION SYSTEMS

SPACE STRUCTURES AND SYSTEMS LAB (S3L)

The S3L research activities include spacecraft structures, nonlinear vibrations, astrodynamics and low-energy spacecraft transfer trajectories, ray tracing methodologies for thermal radiation, system identification, structural health monitoring and vibration mitigation. The S3L mission is to prepare engineers in the fundamental principles and disciplines necessary for the design, implementation, and operation of space and related engineering systems. S3L encourages and offers hands-on involvement of students in real space missions, and in particular in nanosatellite design (i.e., OUFTI-1 and QB50 projects).

www.s3l.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

URBAN AND ENVIRONMENT ENGINEERING RESEARCH UNIT

MATERIALS AND STRUCTURES MECHANICS (M&S)

The M&S offers possibilities for aeronautical firms to carry out mechanical tests on different types of aircraft components like rods, lubrication groups, bearing supports, flaps actuator parts, engines composite or metallic carters. The equipment park includes hydraulic and electro-mechanic machines with a load capacity from 10 kN to 2500 kN. On a test floor, movable static hydraulic jacks (50 to 1000 kN) and movable dynamic hydraulic jacks (100 to 1000 kN) can be used.

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

ADVANCED MATERIALS AND COMPONENTS

MATERIALS AND SOLID MECHANICS (MSM)

MSM team focuses on material models (steel, Ti, Al,...). The development and the identification of constitutive thermo-mechanical-metallurgical laws rely on macroscopic phenomenological or multi-scale approaches and crystal plasticity models. Implemented within FEM codes, these laws predict stress, strain, and damage fields during forming processes, specific static or cyclic loading cases. Since 1984, MSM team has developed its own non linear finite element code Lagamine.

ADVANCED MATERIALS AND COMPONENTS

CHEMICAL ENGINEERING RESEARCH UNIT

CRYOTRIBOLOGY

The main activities of the lab are:

- Physical and chemical properties of environment friendly lubricants
- Self-lubricating function of porous bearings, a simple surface treatment to improve the tribological behaviour
- numerical solutions of non-steady-state conditions of lubrication in internal combustion engine bearings
- Calculation of non-contacting face seals used in space and aeronautic environment
- Comparative analysis of the tribological behaviour of industrial coatings
- Characterization of couples of materials used in space.

www.chemeng.uliege.be

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

ADVANCED MATERIALS AND COMPONENTS

EEI-MONTEFIORE RESEARCH UNIT

APPLIED AND COMPUTATIONAL ELECTROMAGNETICS (ACE)

The ACE group is involved with various aspects of design, modelling and testing of electromagnetic phenomena and devices.

The expertise of its members ranges from static and quasistatic electrotechnics to wave scattering and optics, as well as a wide variety of coupled multiphysic problems involving electromagnetic phenomena.

With more than 150 industrial references, ACE's Electromagnetic Compatibility (EMC) laboratory comprises a semi-anechoic room fully instrumented up to 26 GHz, and a new reverberating chamber. It recently started covering MIL STD 461 and part of RTCA DO 160, which are of particular interest to the aeronautic and space communities.

ace.montefiore.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

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TRAINING AND SIMULATION SYSTEMS

ELECTRONICS, MICROSYSTEMS, MEASUREMENTS, AND INSTRUMENTATION (EMMI)

The EMMI group has strong interest in:

- Developing original microsystem solution for industrial and biomedical applications, with special attention to energy harvesting problems
- Applying and developing sensitive measurement techniques in order to characterize the electrical, thermal, and magnetic properties of various materials
- Applying many-body methods for modeling the electrical, magnetic, or electromagnetic properties of various materials

Microsys laboratory dotation in clean rooms and equipment is well suited to microsystem prototyping.

Microsys conducts inter-disciplinary and cross-disciplinary innovative research in edge-cut fields:

- Exploratory R&D in the field of microsystem R&D in the field of micro-assembly, packaging and interconnect technology
- Microsystem design using off-the-shelf sensors and components, including packaged and bare die
- Pathfinding research on Energy harvesting and scavenging

Microsys is involved in the design and integration of ultra low power wireless sensor microsystems for structural health monitoring and environment sensing in harsh conditions.

www.microsys.uliege.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

SYTEMS AND MODELING (SYSTMOD)

The main study areas and research topics of the unit SYSTMOD are focused on the data mining applied to :

- Industrial quality control
- Industrial production systems
- Industrial production processes
- Environmental data collection systems (sensors networks…)
- Robotics, games, IT systems modeling and simulation of non-linear dynamical systems
- Optimization and optimal control
- Electric energy production and transmission
- Large-scale electric power systems (European electricity transmission network…)
- Biological systems (neuron dynamics, gene-expression, apoptosis…)
- Electricity generation and transmission
- Recommendation systems for e-commerce.

The Systems and Modeling research unit carries out basic research in machine-learning, optimization, control and statistics, and develops cloud storage parallel/distributed computing based applications.

www.montefiore.uliege.be/systmod

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

TRAINING AND SIMULATION SYSTEMS

PROTECTION OF INFORMATION SYSTEMS

INTELSIG

INTELSIG specializes in the acquisition, processing, analysis, and exploitation of a variety of signals and images for a variety of applications. It routinely deals with audio, acoustics, sound spatialization, biomedical signals, medical imaging, radar signals and images, stereoscopic 3D images, ladar images, video analysis, motion analysis, etc. The educational OUFTI-1 nanosatellite was born from the interaction of INTELSIG with the local space industry. INTELSIG provides much of the electronics expertise for the design and construction of the OUFTI-1 ground and space segments. It is the home of a fully operational satellite control and communication ground station, which will be used to control the OUFTI-1 CubeSat.

www.montefiore.uliege.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

TRAINING AND SIMULATION SYSTEMS

SPHERES RESEARCH UNIT

GEOMATICS UNIT

Research has a preponderant place in the activities of the Unit, through numerous research projects and publications. The covered domains are geographical information systems, Space Weather and Global Navigation Satellite Systems, spatial (geographical) data acquisition, processing and mapping.

The Geomatics Unit enjoys a strong international recognition. It also plays a major role to Belgian institutions and to professional people involved in the Geomatics matters.

www.geo.ulg.ac.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

GEODESY AND GNSS UNIT

The research program of the Geodesy and GNSS unit at the University of Liège is focusing on global navigation satellite systems, also known as GNSS (GPS, GLONASS, Galileo, ...). These activities are divided in two main axes :

- The development of calculation algorithms allowing the determination of positions with a high precision level;
- The information reconstruction on the state of the atmosphere and the meteorology of space (water vapor content, free electrons content, …)

Currently, the team is studying the added value of new GNSS (in particular Galileo) as well as the possibility of using low-cost devices such as smartphones in these 2 research axes.

www.spheres.uliege.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

STAR INTERFACULTY RESEARCH UNIT

HOLOLAB

Hololab has built a strong expertise in diffractive optical elements. Its research activities are both fundamental and applied and cover a wide field.

In the frame of space or astronomic instrumentation, Hololab develops diffraction gratings (for spectroscopy) and achromatic phase masks (for coronagraphy) with rigorous modeling and holographic recording processes.

Hololab conducts optical metrology researches based on interferometry techniques (moire, speckle, and shearing).

Based on innovative Fresnel lens combinations, Hololab demonstrates efficient solar concentration solutions.

Both scientific and industrial projects are conducted.

www.star.uliege.be

SYSTEMS AND SUBSYSTEMS FOR DEFENCE AND SECURITY APPLICATIONS

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

MOLECULAR SYSTEMS RESEARCH UNIT (MOLSYS)

THEORITICAL PHYSICAL CHEMISTRY

The TCP group research activities focus on the theory and modeling of the dynamics of molecular systems subject to external perturbations, with applications to

- Molecular logic using quantum intra- and inter- molecular dynamics, with special emphasis on the implementation of massively parallel logic operations and multivalued logic and to quantum computing
- Attochemistry: control of chemical reactivity by ultrafast (attosecond) optical excitation in molecules
- Quantum dynamics of excited states in dense level systems and the control of energy and charge transfer : polyatomic molecules, high molecular Rydberg states, site-selected reactivity in small ionized peptides, arrays of metallic quantum dots
- Electronic, structural, optical, transport and magnetic properties of molecular and nanosystems
- Systems biology: Information Theoretic Approach for the analysis of high throughput genomic and proteomic data

www.tcp.ulg.ac.be

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

PROTECTION OF INFORMATION SYSTEMS

QUANTUM TECHNOLOGIES

LIEGE SPACE CENTER (CSL)

CSL is an Applied Research Centre of the University of Liège dedicated to space in relation with the most prestigious space agencies such as ESA, NASA, JAXA, CNES, CONAE, … Relying on 90 highly skilled and passionate people, CSL develops, assembles, calibrates and/or tests unique instruments and systems capable to operate in the harsh environment of deep space.

CSL is also an actor for the economical deployment of the region through a dynamic participation to technological and data processing application projects with the industry.

www.csl.uliege.be

COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS AND INTELLIGENCE (C41), SENSORS AND DATA PROCESSING

ADVANCED MATERIALS AND COMPONENTS


P1206

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FACULTY OF APPLIED SCIENCES

www.facsa.uliege.be

A&M RESEARCH UNIT

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CHEMICAL ENGINEERING RESEARCH UNIT

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FACULTY OF SCIENCES

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