



Welcome to IPPW9 in ISAE

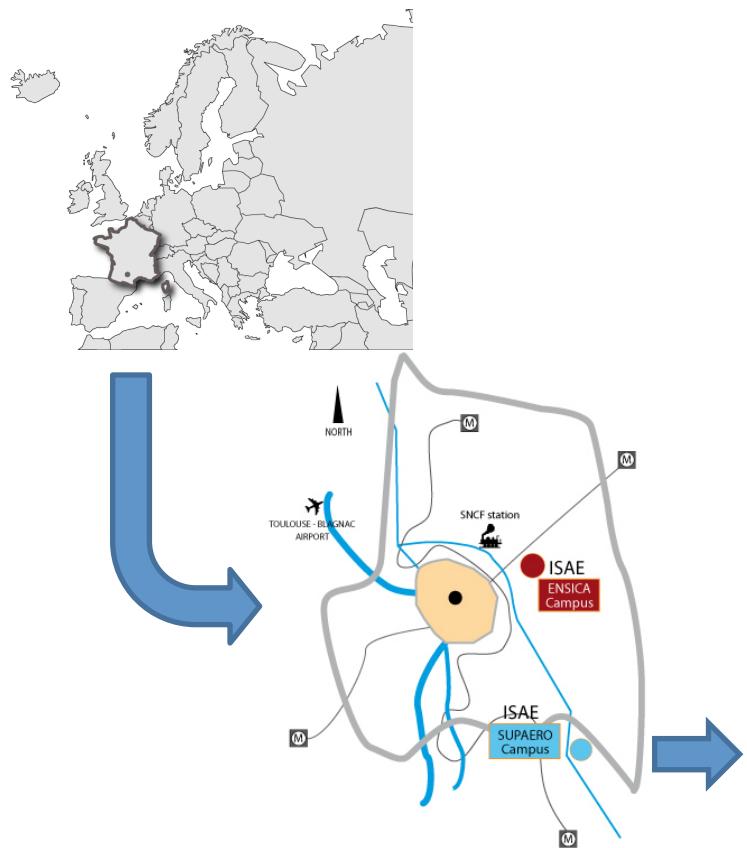
Frédéric Thivet, Scientific VP

www.isae.fr



Location

**In Toulouse
France – Europe**



In the heart of the Aerospace Campus





Toulouse, a major international complex for aeronautics and space

- **Toulouse**

850,000 inhabitants



- **Aerospace Valley world-class industry cluster**



- **The main European Pole for Aeronautics and Space**

- **Aeronautics:** AIRBUS, EADS, ATR, SAFRAN, THALES, Liebherr Aerospace, Rockwell Collins, Latécoère, Air France

- Manpower : **53,000** - including **5,000** researchers
 - Leading European centre for civil aviation industry



- **Space:** EADS ASTRIUM, THALES ALENIA SPACE, CNES

- Manpower : **12,000** (**25%** of the European manpower)
 - Leading European centre for satellites industry and earth observation





Université de Toulouse

6 founding members (2007)

- INP Toulouse
- INSA Toulouse
- **ISAE**
- UT1 Capitole (Economy, Law, Mgmt)
- UT2 Le Mirail (Arts, Languages, Social Sci.)
- UT3 Paul Sabatier (Sciences & Med.)

Goals

- | | |
|-----------------------|--|
| • Research | To promote regional research |
| • Ph.D | To coordinate Ph.D. Programs and theses delivery |
| • Attractivity | To enhance international visibility and attractivity |
| • Projects | To develop societal and multi-disciplinary projects |
| • Insertion | To enhance professional insertion of graduates |
| • Services | To gather service activities to the benefits of students |
| • Opening | To associate all regional higher education and research establishments |



Key figures

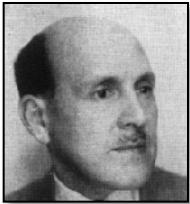
- | | |
|---------------------------------|---------------|
| • Students | 94 000 |
| – Bachelor | 40 000 |
| – Master | 27 500 |
| – Ph.D. | 4 000 |
| – Other pgms | 22 500 |
| • Ph.D. Programs | 15 |
| • Laboratories | 172 |
| • PhDs defended per year | 781 |
| • Professors | 6520 |
| • Permanent staff | 6113 |

A new institute with a long history

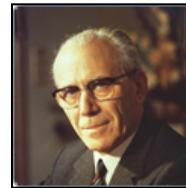
- **1909** creation of Ecole supérieure d' aéronautique et de constructions mécaniques by colonel Jean-Baptiste Roche
 - **1930** becomes Ecole nationale supérieure d' aéronautique (SUPAERO)
 - **1968** moves to Toulouse
 - **1972** becomes Ecole Nationale Supérieure de l'Aéronautique et de l'Espace
- **1945** creation of Ecole nationale des travaux aéronautiques (ENTA)
 - **1957** becomes Ecole nationale d 'ingénieurs des constructions aéronautiques (ENICA)
 - **1961** moves to Toulouse
 - **1979** becomes Ecole Nationale Supérieure des Ingénieurs des Constructions Aéronautiques (ENSICA)
- **2007** SUPAERO and ENSICA become ISAE
ISAE is a founding member of Université de Toulouse
- **2009** SUPAERO is 100 years old



Some famous alumni



Raoul Badin, SUPAERO 1910,
inventor of Liquid-level indicator and
Air-speed indicator



Henri Ziegler, SUPAERO 1931,
who contributed to create Airbus



Henri Coanda, SUPAERO 1910,
expert in aerodynamics and designer of the
first thermojet powered aircraft



Constantin Kostia Rozanoff,
SUPAERO 1933,
the first to reach Mach 1 in a French aircraft



Henri Potez, SUPAERO 1911,
co-inventor of Potez-Bloch propeller,
founder of Potez Aeronautique



Pierre Satre,
SUPAERO 1934, father
of Caravelle



Marcel Bloch-Dassault, SUPAERO 1913,
inventor of Hélice Eclair propeller, founder of
Dassault Aviation

François Hussonot, SUPAERO 1935,
inventor of Cockpit Voice Recorder

Some famous alumni



Serge Dassault, SUPAERO 1951,
President of Dassault Industries



Frédéric d' Allest, SUPAERO 1966, father of
Ariane launcher



Alexis Kniazeff, SUPAERO 1966, founder
of Altran Technologies



Rachid Benmokhtar,
ENSICA 1967, former Minister of Education (Morocco)



Jean-Claude Laprie,
ENSICA 1968,
former director of LAAS-CNRS



Claude Lelai, SUPAERO 1970,
Chief Pilot of A380 maiden flight

Roger Welaratne, ENSICA 1986, Senior VP,
Sales & Marketing at GE



Xavier Lagarde,
ENSICA 1972,
Member of board SAFRAN



Laurent Collet-Billon,
SUPAERO 1974, Head of DGA
Délégation Générale pour l' Armement



Jean-Paul Herteman,
SUPAERO 1975,
President of SAFRAN



Jean-Marc Nozeran, SUPAERO 1976,
CEO Continental Automotive



Jean-Francois Clervoy,
SUPAERO 1983, astronaut



Christophe Robin,
ENSICA 1991, President of DynAero



Identity profile

Staff - Budget

- > Staff: 440
- > Budget: 60 M€

Lecturers

- > 2000
- > + 36 000 h/an

Network

- > 19 000 alumni

Students

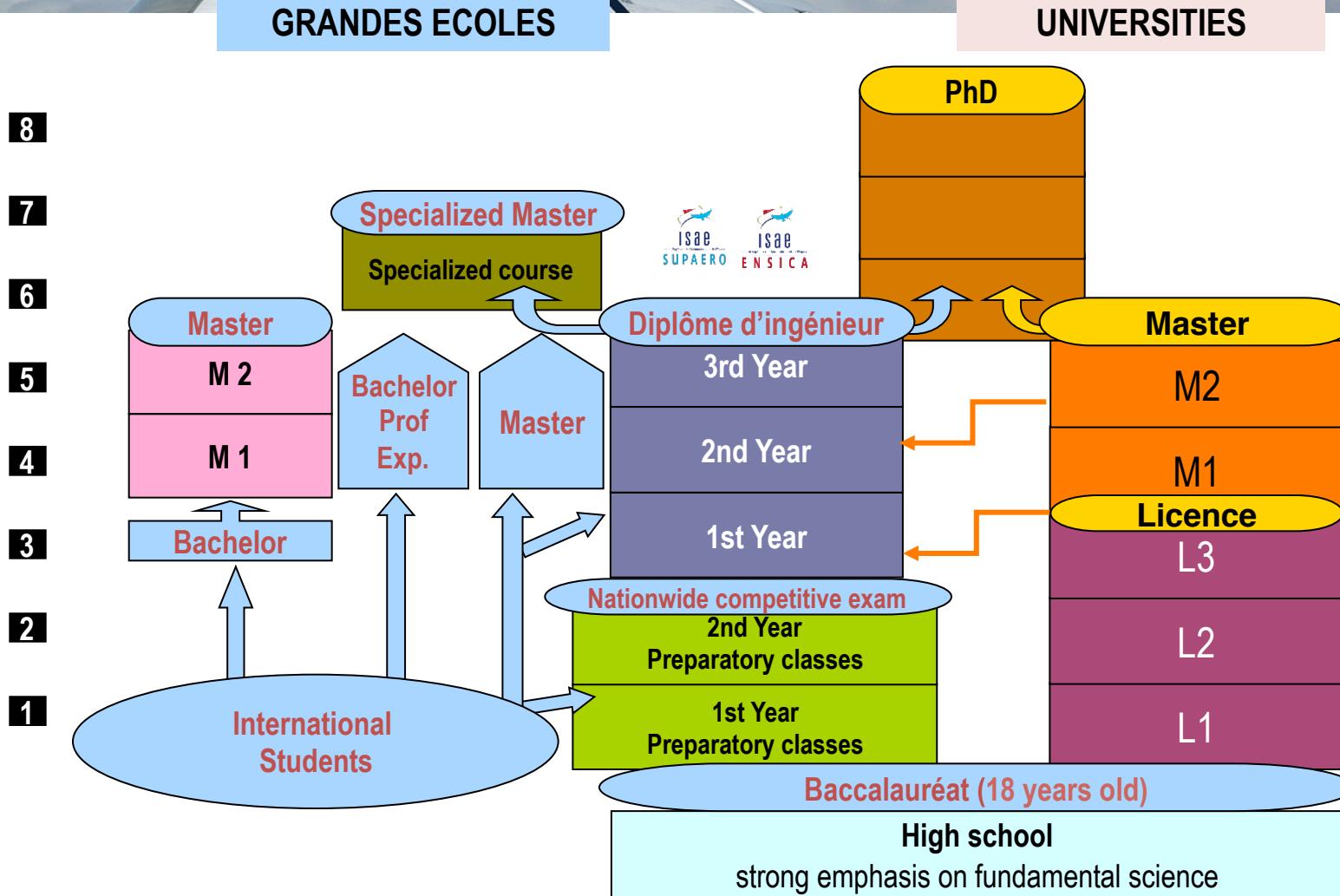
- > 1500 incl. 26% from abroad
- > SUP & N6K grad. pgms: 1000
- > MSc and Advanced Masters: 300
- > Ph.D: 200



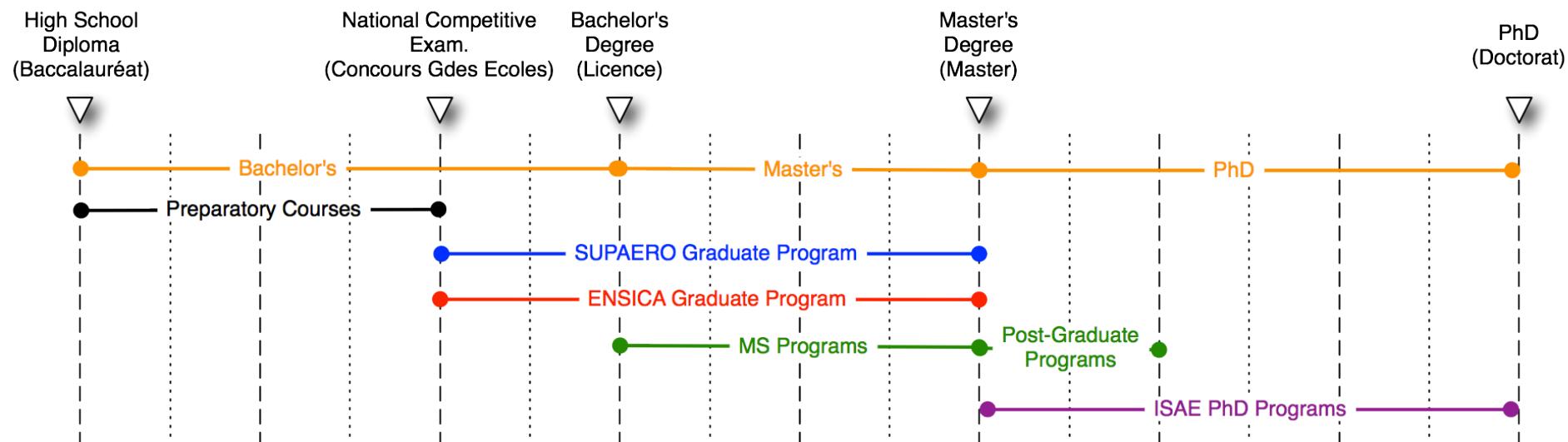
Institut Supérieur de l'Aéronautique et de l'Espace



The French System



The French & European Academic System



ISAE Graduate and Post-Graduate Programs

- **2 Engineer Graduate pgms (3 yrs)**

- SUPAERO Graduate Program
- ENSICA Graduate Program



- **3 Masters of Science (2 yrs after a BSc)**

- Aerospace Mechanics and Avionics (AMA)
- Aeronautical and Space Systems (AESS)
- Global Navigation Satellite System (GNSS)

- **18 Advanced Masters (1 yr postgraduate)**

- 14 in Toulouse – 10 taught in English
- 1 with HEC, in Toulouse & Paris
- 3 with CAUC, in Tianjin – PR China

- **Continuing Education**

- **5 Research Masters**

in addition w/ SUPAERO or ENSICA graduate programs

- Fluid Dynamics, Energetics and Transfers
- Mechanical Engineering
- Astrophysics, Space Sciences, Planetology
- Fundamental and Applied Mathematics
- Computer Science and Telecommunications



- **6 PhD Programs**

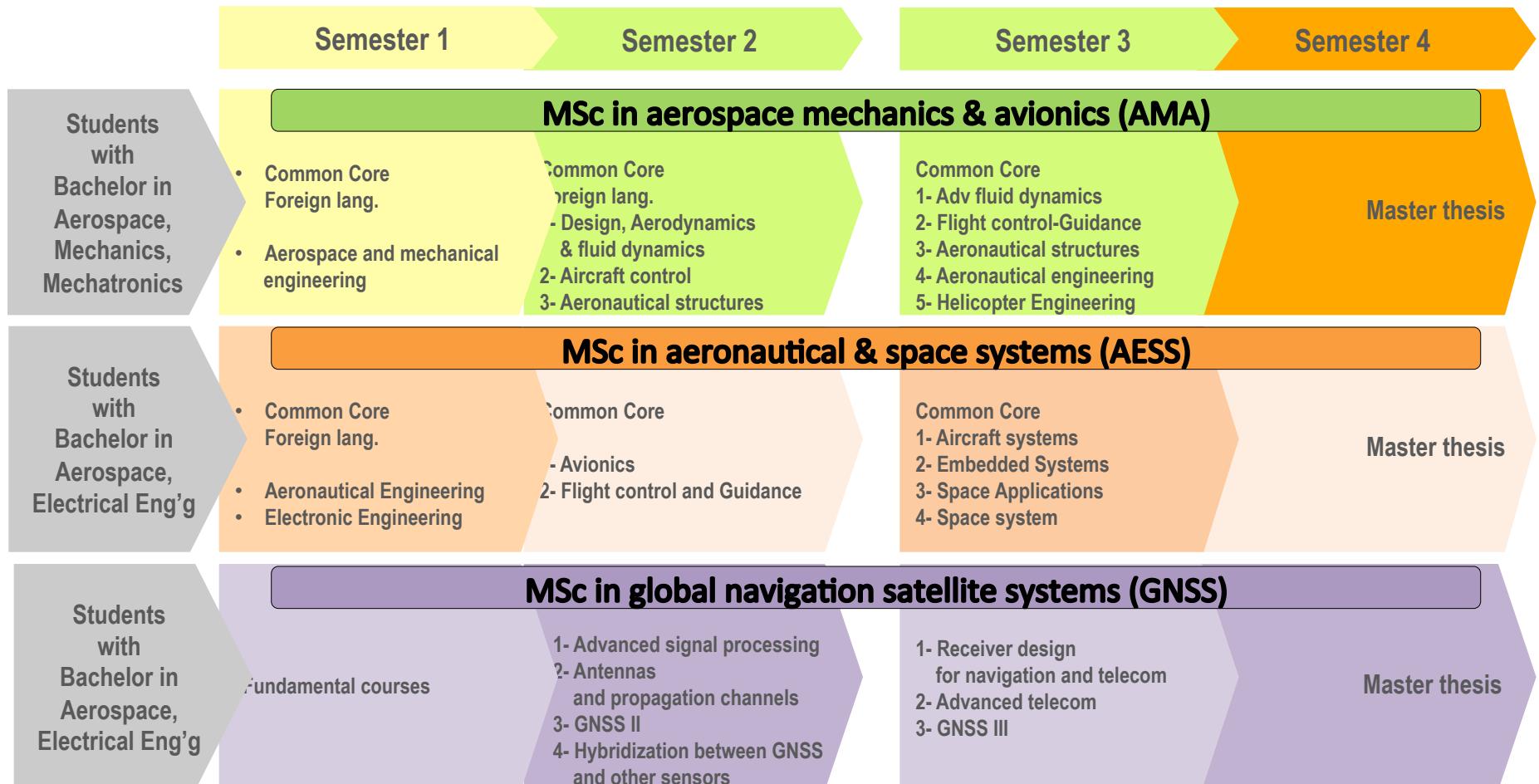
- Mechanics, Energetics, Civil Eng'g, Processes
- Electrical Engineering, Telecoms
- Universe, Space and Environment Sciences
- Mathematics, Computer Sc., Telecoms
- Systems
- **Aeronautics and Astronautics**



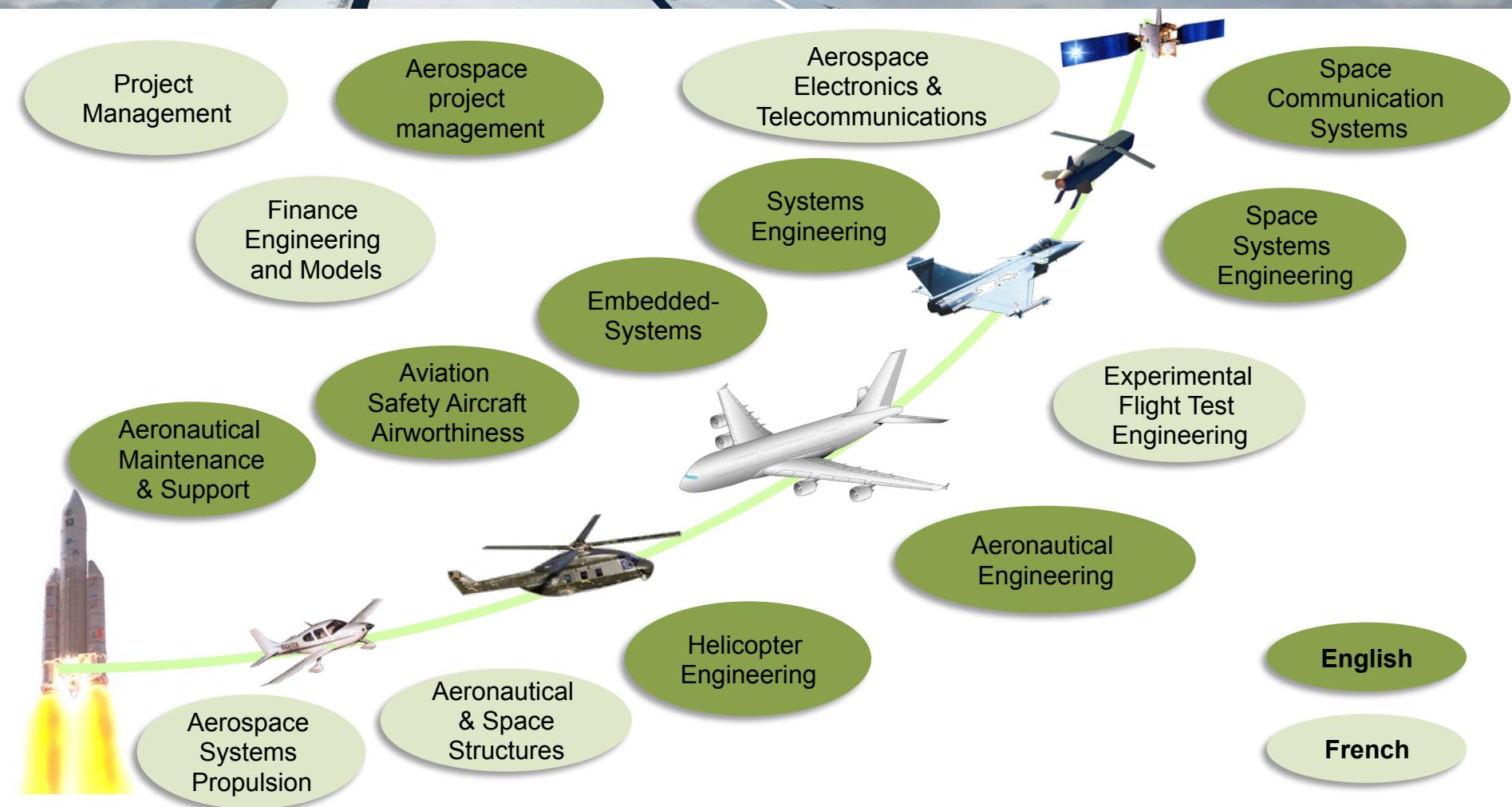


3 Masters of Science

A Comprehensive MSc Offer for personalized education path

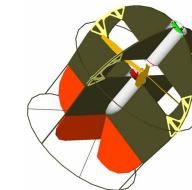


A comprehensive set of Advanced Masters



Training and Research Demonstration Projects

- Micro Air Vehicles
- IMAV Conference and Flight Competitions
- Micro Transat Challenge
 - ISAE i-Boat prototype
 - Micro-transat: world record in 2010 (still holding): 108 km of autonomous navigation on sea
- Perseus
 - ISAE – ONERA cooperation
 - 2011 CNES C' Space micro-launchers: a world 2nd hybrid propulsion demonstration
- CanSat
 - ISAE – University of Samara cooperation
 - a 2012-2014 project
- QB50
 - an international network of 50 CubeSats for multi-point, in-situ measurements in the lower thermosphere and re-entry research
 - ISAE – ONERA cooperation, CNES Support, VKI Call





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- > MSc and Advanced Masters: 300
- > Ph.D: 200

Training Programs

- > SUPAERO graduate program
- > ENSICA graduate program
- > 3 Masters of Science
- > 18 Advanced Masters
- > 5 Research Masters
- > 6 Ph.D programs

In Europe, 25% of M degrees
in AE are delivered by ISAE





Relations with companies

- **A strategic partnership with 14 companies**

- ACCENTURE
- AKKA TECHNOLOGIES
- AIR FRANCE
- ALTRAN
- CNES
- DASSAULT
- LIEBHERR
- EADS AIRBUS
- EADS ASTRUM
- EADS EUROCOPTER
- EADS SOGERMA
- SAFRAN
- THALES
- ZODIAC AEROSPACE



- **Many conferences made by companies intended for ISAE students**

- Made by SUPAERO or ENSICA alumni
- Visits

- **ISAE SUPAERO Foundation**

- Contribute to the national and international influence of ISAE
- Support the international mobility of students and professors
- Foster the development and influence of research
- Encourage social openness at ISAE





International relations

- **Co-operation with many universities in the World**

- **80 academic partners (universities) in 25 countries** (TU Munich, TU Berlin, ULB, UPM, UPC, Cranfield, Politecnico Milano, MIT, Stanford, Georgia Tech, NUAA, NPU Xi'an....),
- **39 double degree possibilities** (through a particular agreement): mobility between 18 and 24 months from the 3rd year,
- **Substitution of one or two semesters** (mostly through ERASMUS) mainly during the 3rd year.

- **Internships abroad**

- Many students achieve their **master thesis** abroad and so they start their career in a foreign country.





International relations

- **Outgoing students**

- **Obligation** for the SUPAERO and ENSICA students to stay abroad:
 - at least 2 months (academic exchange, internships, projects),
- **55 SUPAERO students** in academic exchange abroad during the year 2009-2010,
- **32 ENSICA students** in academic exchange abroad during the year 2009-2010
 - mostly United States, United Kingdom, Germany, Sweden, Canada
 - but also China, Japan, Denmark, Russia, Switzerland or Netherlands...

- **Incoming students in the SUPAERO and ENSICA graduate pgms**

- **101 students** (2009-2010)
 - mostly from Spain, Belgium, Italy, Germany, Brazil, Portugal.





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International

- > 80 exchange agreements (25 countries) incl. 39 double degrees
- > EuMAS - Erasmus Mundus Master – European Masters Course in Aeronautics and Space Technology
- > PEGASUS - Partnership for a European Group of Aeronautic and Space Universities (23 partners)
- > TIME – Top industrial managers for Europe (41 partners)
- > SIAE - Sino Institute of Aeronautics Engineering (Tianjin, China)



Excellence with passion **I' Espace**

Institut Supérieur de l'Aéronautique et de **I' Espace**



ISAE research policy and skills

Frédéric Thivet, Scientific VP

www.isae.fr



ISAE Research

Key figures 2011

- > 175 scientific and technical staff
- > 250 Ph.Ds and post-docs
- > +10% / yr from 2007 to 2011:

▪ Profs and Researchers +	15 %	126
▪ Rank A publis /fac./yr +	44 %	1,1
▪ HDR +	27 %	52
▪ PhD +	78 %	213
▪ Turnover +	57%	24,6 M€
▪ Patents +	100 %	9

Research Policy

- > A strong link between Training and Research
- > An internat. training centre for masters and Ph.D
- > A good balance between academic production and technological innovations
- > Aeronautics, Space , Embedded Systems and connex systems

Long-term Partnerships



Strategic Partnership



Communication Networks



Mechanical Engineering

Local Networks

- > Univ. of Toulouse
- > Aerospace Valley
- > STAE Ntwk of excel.
- > AA PhD program



Industry Chairs

- > CRISTAL ASTRIUM-ISAE - space imagers
- > SAFRAN ISAE HEC – innovation managm't



Telecoms for Space and Aeronautics



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Research

- > 126 faculty + 50 technical staff
- > 100 scientific projects / yr
- > 24,6 M€ Turnover

Training Programs

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Training and Research Departments

DAEP

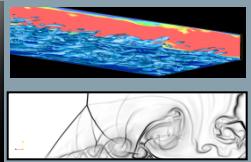
Aerodynamics, Energetics & Propulsion

Turbulence and Instabilities

Turbomachinery and Propulsion

Advanced Aerodynamics and Flow Control

Aerodynamics and Propulsion of MicroUAV



DEOS

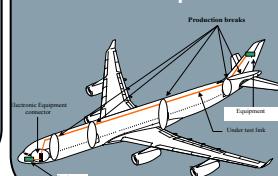
Electronics, Optronics & Signal Processing

MOSE Microwaves and Optronics for Embedded Systems

CIMI Integrated 2D Imager Design (CMOS)

SCAN Signal, Communication, Antennas, Navigation

SSPA Space Systems



DMSM

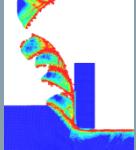
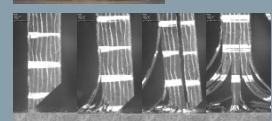
Mechanical Eng'g, Structures & Materials

Damage to Composite St.

Fatigue of Metal Mat. & St.

Dynamics of St.

Advanced Numerical Methods



DMIA

Mathematics, Computer Sciences & Control

MARS Modeling and Architecture of Systems

ADIS Control, Decision and Interface of Systems

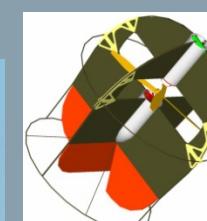


LACS

Languages, Arts, Cultures & Society



Aeronautics & Space Center



CAS

The Aeronautics and Space Center

Head: Christian Colongo, christian.colongo@isae.fr

Staff: 17

- 2 Faculty
- 4 PhD students
- 5 engineers and technical staff
- 3 pilots, 3 aircraft mechanics



Laboratory resources

- Satellite simulator
- Satellite ground station network (coop. with MIT)
- Aerospace systems design & modeling tools
- Full flight simulator : generic, fully configurable, airliner FFS



Flying assets

- 9 light training aircraft
- 1 advanced instrumented TB20 aircraft





Staff: 44

- 17 Faculty
- 10 PhD students
- 17 Technical staff



Laboratory resources

- Hot-wire anemometers
- Laser Doppler Velocimetry
- Particle image
- Variable Pressure/Temperature

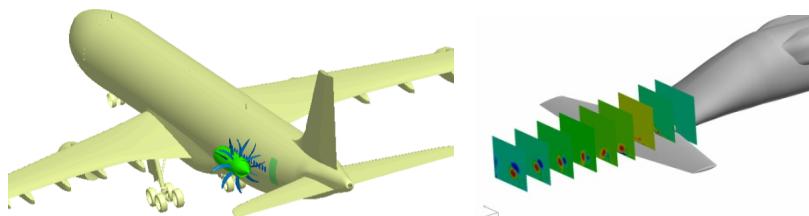
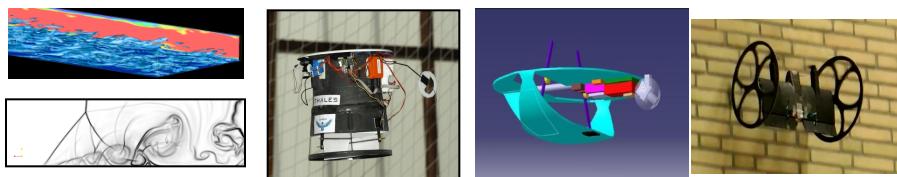


Specific facilities

- S4 large wind tunnel
- SABRE low-Re wind tunnel
- Jet engine test bench
- Compressor test bench
- Turbochargers test bench

Research Themes

- Turbulence and modelling
- Turbomachines and propulsion
- Advanced aerodynamics and flow control
- Aeropropulsion of micro-air vehicles



Partnerships

- ONERA
- Airbus, Safran, Dassault Aviation
- Liebherr Aerospace, Honeywell Garrett



DMSM

Mechanics of Structures and Materials

Head: Prof. Jacques Huet, jacques.huet@isae.fr

Staff: 53

- 14 Faculty (+10 visiting)
- 18 PhD students
- 19 Technical staff

Production and study resources

- Workshop, CAD/CAM
- Metrology (3D, surfaces)

Laboratory resources

- Static mech testing and fatigue from 3 to 30t
- Dynamics: Hopkinson bars, low-energy impact, gun
- Physico-chemical characterisation of materials
- Workshop for composites
- NDT, microscopy (SEM, ESEM)

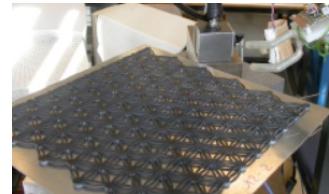
Specific facilities

- Modular frames for structures testing
- Drop tower
- Climatic chambers

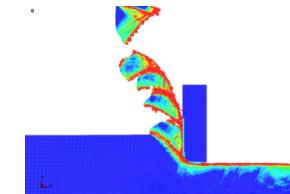
Research Themes

- Damage to composite materials in aerospace st.
- Fatigue of metallic materials and structures
- Dynamics: Vibrations Dissipation and Structural Control
- Advanced numerical methods for mechanics

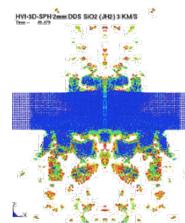
Passive damping



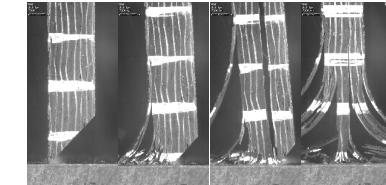
Milling modelling



Hyper fast impact



Crash



Partnerships

- CNES, ONERA
- Airbus, EADS IW, Latécoère, Eurocopter



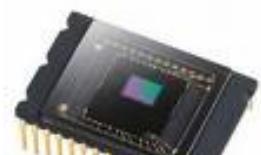
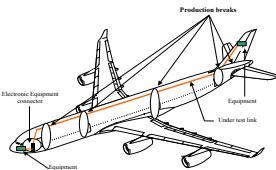
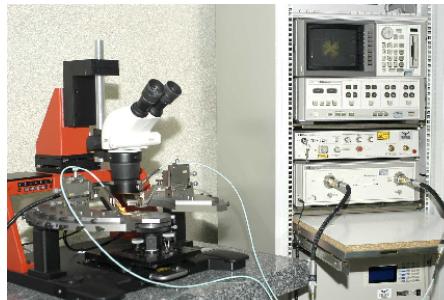


Staff: 53

- 22 Faculty
- 21 PhD students
- 10 Technical staff

Laboratory resources

- Advanced electronic and optical instrumentation
- Faraday cages
- Laser sources
- Wafer probers
- Many electronic / optical simulation softwares



4 Research Groups

- MOSE Microwaves and optics for embedded systems
- CIMI Integrated matrix image sensors
- SCAN Signal, Communication, Antennas, Navigation
- SSPA Space Instrumentation

Partnerships

- ONERA, CNES, ESA, DGA, Astrium, Thales, Airbus, IPGP



From research to innovation → Astrium-ISAE CRISTAL Chair

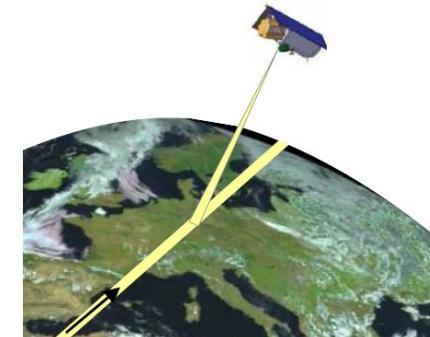
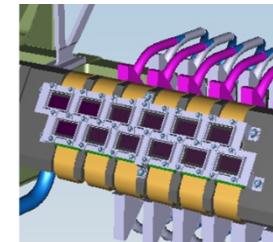
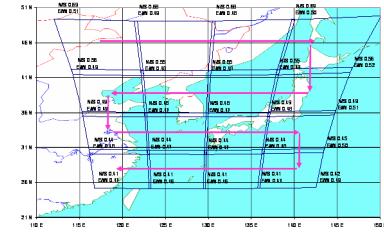
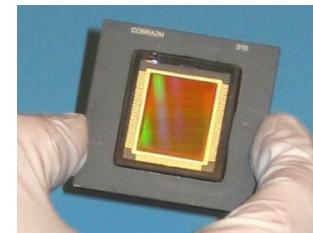
CMOS Research on Imagers for Space Technologies and Applications

Chair including

- Research: excellent academic performances
- Industrial realisations

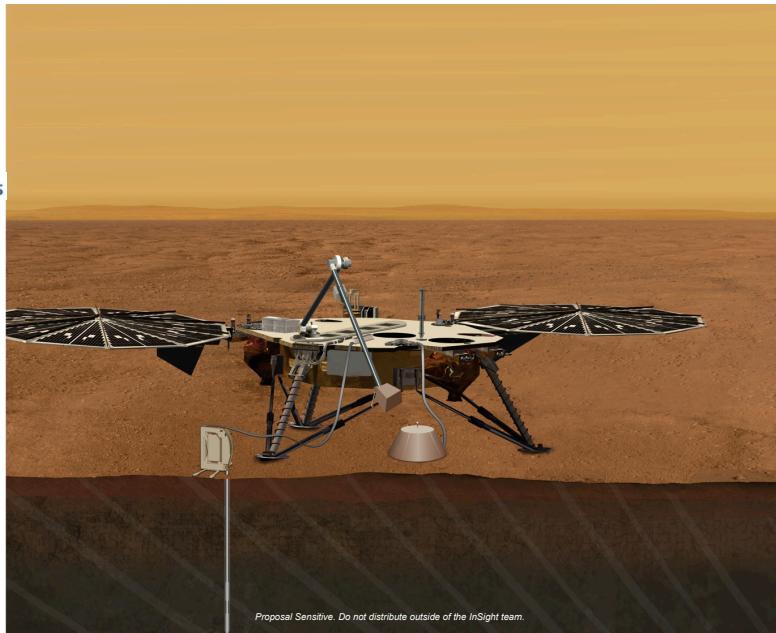
World firsts

- PEA LOLA 2008 → world 1st
 - Optical link b/w a satellite and a plane
- GOCI 2010 → world 1st
 - Geostationary Ocean Color Imager
 - ASTRIUM satellite for South Korea
- ESA Sentinel 2 2013
 - VNIR sensor
 - GMES Program

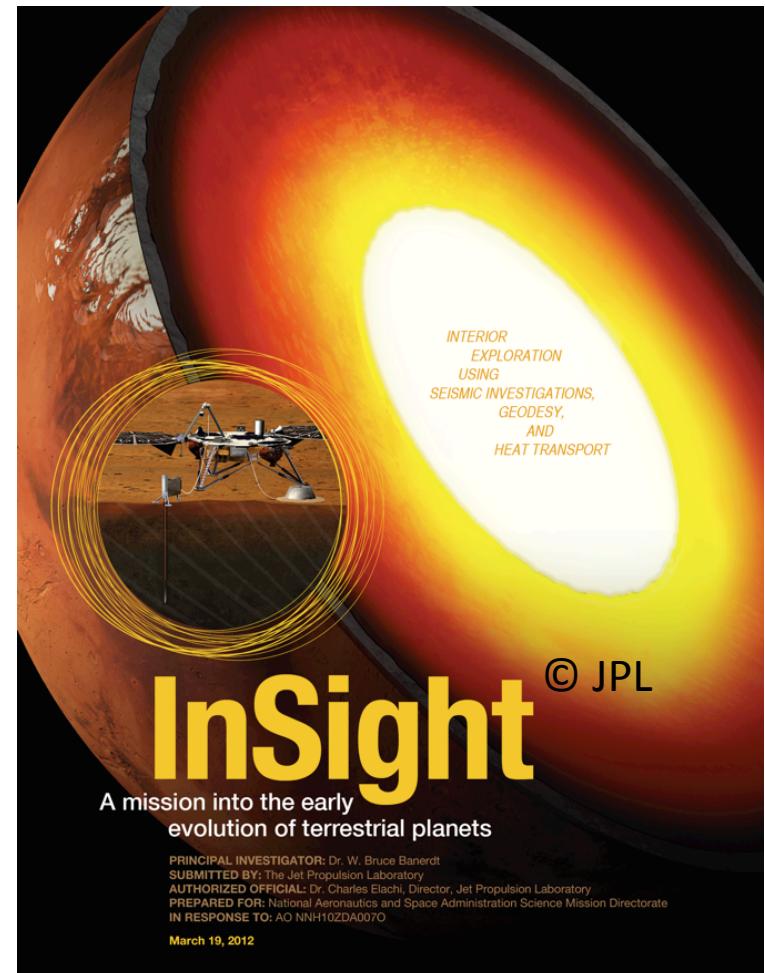




- NASA Discovery Mission – MARS exploration
- Phase A: 3 projects selected
incl. INSIGHT – prime: JPL
- Principal instrument: seismometer
- D. Mimoun (ISAE) Co-I and instrument lead



June 2012





Mathematics, Computer Science and Control Design

Head: Prof. Patrick Sénac, patrick.senac@isae.fr

Staff: 70

- 26 Faculty
- 29 PhD students
- 15 Technical staff

Laboratory resources

- Computing cluster
- Cooperative robotics
- Network emulator
- Control and command of systems

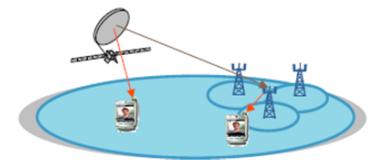
Partnerships

- ONERA , LAAS-CNRS
- TeSA: CNES, Thales Alenia Space
- Ratier-Figeac

MARS team

Systems Modelling and Architecture

- Mathematical modelling, simulation, operation managmt
- Critical Systems Engineering
- Communication networks



ADIS team

Control, Dynamics and Interface of Systems

- System engineering, modelling & control
- Aircraft design
- Human factors





Research with industry 12 frame agreements on a 5-yr basis

2 Chairs supported by Industry

- EADS Astrium – **CRISTAL** Chair – Research on CMOS Imagers for Space Technologies and Applications
- SAFRAN-HEC-ISAE Chair on innovative program management – Application to aerospace

2 Common Laboratories

- Thales Alenia Space, Rockwell Collins, CNES, 4 academic partners – **TeSA** – Telecom for Space and Aeronautics
- EADS IW – ICA – **3AS** Research Group – Advanced Analysis for Aeronautical Structures

8 Frame agreements with an active research section

- AIRBUS – advanced aerodynamics, structures, optical link, human factors
- SAFRAN (Snecma, Turbomeca, Technofan) – off-design engine operation , engine modeling, turbofan
- EUROCOPTER – helicopter engineering, composite structures, vibrations
- MBDA Missile Systems – european collaborative agreement (w/ Cranfield, Munich, U. Pise, ETSIA Madrid)
- BERTIN TECHNOLOGIES – convertible micro-aerial vehicles
- CEA – shock /fluid interface interactions
- LIEBHERR
- SOGETI

Training and Research Departments

DAEP

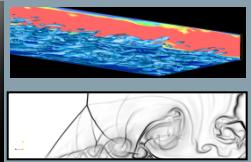
Aerodynamics, Energetics & Propulsion

Turbulence and Instabilities

Turbomachinery and Propulsion

Advanced Aerodynamics and Flow Control

Aerodynamics and Propulsion of MicroUAV



DMSM

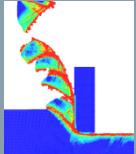
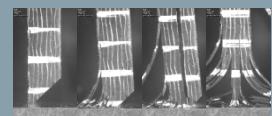
Mechanical Eng'g, Structures & Materials

Damage to Composite St.

Fatigue of Metal Mat. & St.

Dynamics of St.

Advanced Numerical Methods



DEOS

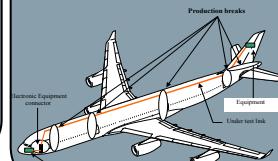
Electronics, Optronics & Signal Processing

MOSE Microwaves and Optronics for Embedded Systems

CIMI Integrated 2D Imager Design (CMOS)

SCAN Signal, Communication, Antennas, Navigation

SSPA Space Systems



DMIA

Mathematics, Computer Sciences & Control

MARS Modeling and Architecture of Systems

ADIS Control, Decision and Interface of Systems

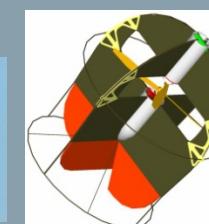


LACS

Languages, Arts, Cultures & Society



Aeronautics & Space Center



CAS



Identity profile

Staff - Budget

- > Staff: 440
- > Budget: 60 M€

Lecturers

- > 2000
- > + 36 000 h/an

Network

- > 19 000 alumni

Students

- > 1500 incl. 26% from abroad
- > SUP & N6K grad. pgms: 1000
- > MSc and Advanced Masters: 300
- > Ph.D: 200

Research

- > 126 faculty + 50 technical staff
- > 100 scientific projects / yr
- > 24,6 M€ Turnover

Training Programs

- > SUPAERO graduate program
- > ENSICA graduate program
- > 3 Masters of Science
- > 18 Advanced Masters
- > 5 Research Masters
- > 6 Ph.D programs

In Europe, 25% of M degrees
in AE are delivered by ISAE

International

- > 80 exchange agreements (25 countries) incl. 39 double degrees
- > EuMAS - Erasmus Mundus Master – European Masters Course in Aeronautics and Space Technology
- > PEGASUS - Partnership for a European Group of Aeronautic and Space Universities (23 partners)
- > TIME – Top industrial managers for Europe (41 partners)
- > SIAE - Sino Institute of Aeronautics Engineering (Tianjin, China)





Welcome to IPPW9 in ISAE

Frédéric Thivet, Scientific VP

www.isae.fr