



**ECOLE NATIONALE SUPERIEURE  
DE MECANIQUE ET D'AEROTECHNIQUE**



## ISAE-ENSMA

The reference school in aeronautical and space design for CCP,  
the competitive entrance examination to Grandes Ecoles



## The ISAE Group

1<sup>st</sup> world center of training and research  
in aeronautical and space engineering



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Aeronautics - Space - Transport - Energy



## Seen as a reference on its territory and its region,

member of the ISAE group, world leader in aerospace engineering higher education and research, ISAE-ENSMA successfully faces the industrial and societal challenges, in the fields of transport and energy, by training high level engineers, able to manage complex projects, showing leadership to manage teams and organizations, and initiative for entrepreneurship, in a worldwide highly connected environment.

This approach guides the training program of the ISAE-ENSMA engineers for the next few years. The program is supported by many academic and industrial partnerships, as well as research projects of excellence, closely linked to high-level courses.

Founded in Poitiers in 1948, ENSMA has been located since 1993 next to the site of Futuroscope. In 2011, ENSMA turns a corner by taking on the name of ISAE-ENSMA by creating, with ISAE-SUPAERO, the ISAE Group, the 1st world centre of training and research in aeronautical and space engineering.

The programs is extensive, covering fields such as fluid and structure mechanics, aerodynamics, energy, heat transfer and propulsion, materials, real-time computer science... Many industrials participate to the teaching activities, and share with students their professional experiences, in the framework of industrial chairs and sustainable partnerships.

Humanities and social sciences are also included in the programs, as well as a solid international culture, to strengthen the expertise of our students.

Our students are strongly involved in their education, through innovative projects, they are the next generation of scientists and managers, able to meet the industrial and societal challenges of the future.

The following pages give a fairly complete description of our school. I hope you enjoy reading it.

Prof. Roland Fortunier  
Director of ISAE-ENSMA

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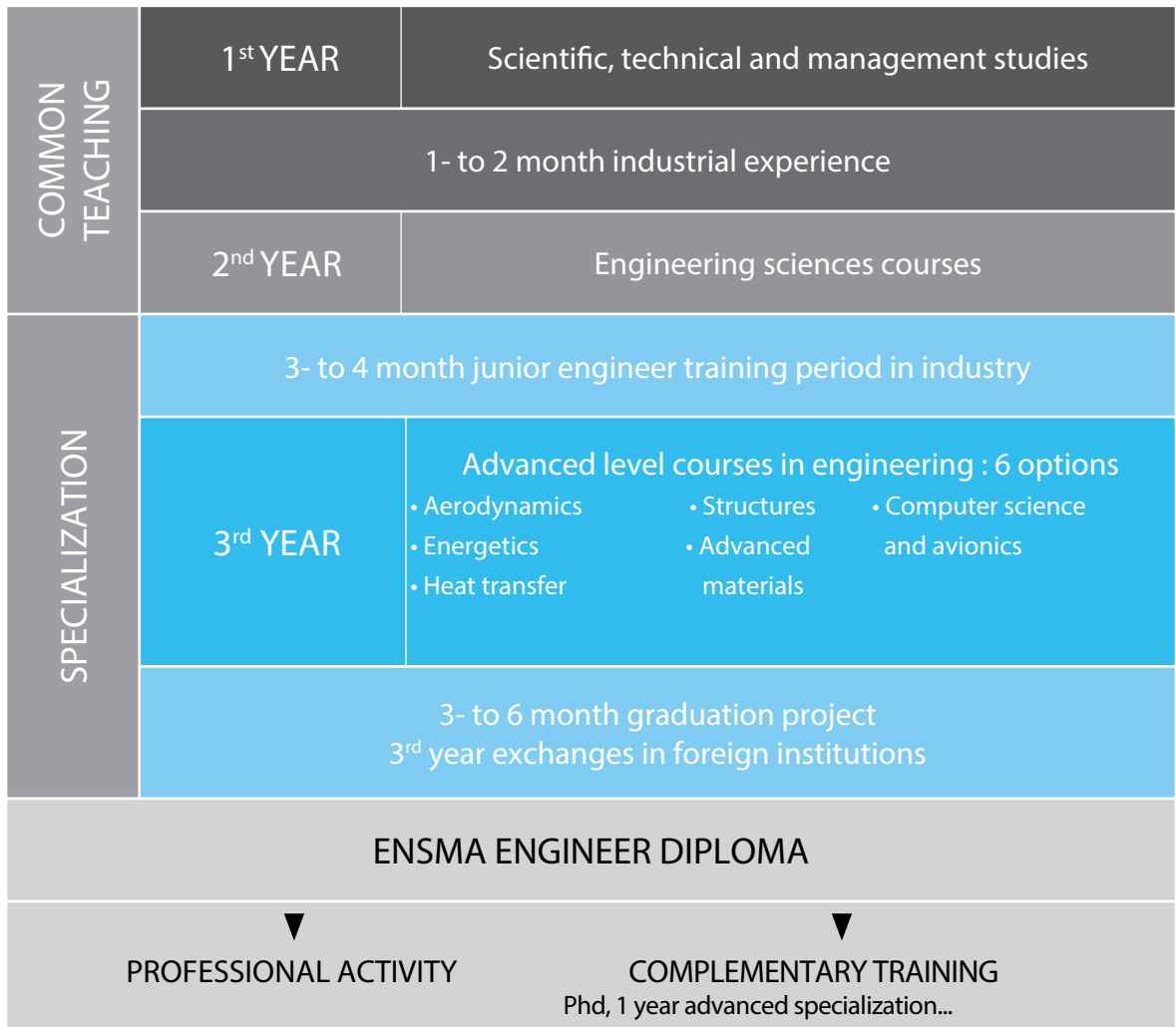
### INCLUSION

The school works actively on a disability policy aimed at improving skills in implementing the facilities necessary to welcome and support students. ISAE-ENSMA works, with the Disability Department of the University of Poitiers and the certified doctors, on the most appropriate arrangements for students with disabilities.

All students with disabilities (whether officially recognized or not), students with health problems such as sensory impairments (hearing or visually impairment), physical, psychological or specific learning difficulties (special needs) disorders, autism spectrum conditions and long-term medical conditions are welcome to contact the school at [referenthandicap@ensma.fr](mailto:referenthandicap@ensma.fr) for assistance.



# TEACHINGS



## TEACHINGS DEPARTMENTS AT ENSMA

### FLUID MECHANICS AND AERODYNAMICS

The basic concepts are taught as of the first year. The students who wish to deepen their knowledge can follow, in third year, specialized courses : extern, intern and numerical aerodynamics and turbulence. The equipment of the school in subsonic and supersonic wind tunnels enables to illustrate the concepts introduced in class.

### ENERGETICS AND HEAT TRANSFER

After the thermodynamics of the engines, thermal transfers, combustion and detonics science are covered. All the areas are thus joined together for the entire study of the industrial facilities. The equipment of the school enables to reproduce the phenomena to study them in real size.

## MATERIALS AND STRUCTURES

The study of structures and materials, on macroscopic and microscopic scales, starts in first year. More specific subjects are covered (plasticity, damages, laminates, polymers, x-rays...) so that the students familiarize with the modern evaluation methods of the numerical and experimental constraints used in industry.

## COMPUTER SCIENCE AND AUTOMATICS

The study of languages and techniques of scientific and industrial computer science is an important part of the core curriculum. The 3rd year option « Computer science and avionics » (software engineering, embedded real-time systems, data engineering, human-machine interface...) trains engineers specialized in the integration of these new tools in this area of interest.

## ENGINEERING OF INDUSTRIAL SYSTEMS

The technological culture is at the heart of the engineering sector and the design manufacturing process of an industrial product. From practical examples, the offered teaching is based on CAD using 3-D modeling software supporting the liaison between different fields (structures calculus, aerodynamics, thermal science...). The aim is to the develop synthesis, innovation and open-minded spirit skills towards industry. Technology is taught in 3rd year of studies through engineering design projects.

## MANAGEMENT AND LIBERAL STUDIES

In a spirit of internationalization, the school delivers training in foreign languages necessary for the future engineers. Moreover, sport activities are integrated into the teaching with weekly courses and several university competitions. Finally, the resource centre and the library offer the students the opportunity to work in quiet places, have access to a range of diverse documents and the use of the new communication tools.





# PROGRAM : PERFORMANCE, RIGOR, IMAGINATION

## A TRAINING IN MECHANICS AND AERONAUTICS

### Extensive fields of competence :

- combining rigorous theoretical training and a thorough technological experience,
- centered on the fields of mechanics and energetics,
- focused on aeronautics and space, ground transportation and energy industries.

### A preparation for an engineer's career to :

- anticipate fast technological developments,
- develop innovation abilities,
- take on the new duties and tasks of the engineer,
- ensure the best integration into the companies.

### The development of personal qualities to :

- carry out a professional project,
- learn autonomy and team work,
- communicate.



## FIRST STEPS IN COMPANIES

*The 3 internships can be performed either in France or abroad.*

### Blue-collar internship : a 1- to 2 month placement at the end of the 1<sup>st</sup> year

During this first internship, students work as blue-collar workers and discover the world of production. They learn to value the importance of human and social relations within a company.

### Junior Engineer training : a 3- 4 month placement at the end of the 2<sup>nd</sup> year

This internship, supervised by an engineer, allows them to discover first-hand what the work of an engineer entails.

### Graduation project : a 3-to 6 month placement at the end of the 3<sup>rd</sup> year

Enables the students to supplement their training according to their professional project (industry, research, international ...). A 3-to 6 month placement that can be carried out in a company, in a university or in a research laboratory.

### Engineering design project

Developed in partnership with companies, these works allow the students to grasp a problem in general.



ENSMA graduates are mainly recruited by large national and international companies - Airbus Group, Dassault Aviation, Groupe Safran, ArianeGroup, Stelia Aerospace, CNES, MBDA, Renault, PSA, Thales, EDF, Alstom, ... or by associated service providers such as Altran, Teuchos-Groupe Safran, Sogeti High Tech, AKKA Technologies...

► Contact : [stages@ensma.fr](mailto:stages@ensma.fr)

*SOME INTERNSHIPS EXAMPLES :*

**AIRBUS HELICOPTERS, Munich, Allemagne**

Analysis and simulation of impacts on carbon composite components

**THALES ALENIA SPACE, Cannes la Bocca**

Applicability of phase transformation materials for the thermal control of an instrument

**ALTRAN TECHNOLOGIES, Vélizy-Villacoublay**

Structural bio-composites in automobile industry

**BOMBARDIER AERONAUTIQUE, Montréal, Canada**

Development of an acoustics analysis code on noise emission from air traffic

**CEA-CESTA, Le Barp**

Study of laser tests equivalent to hyper-fast impacts

**DASSAULT AVIATION, Mérignac**

Analysis of a refined finite elements model from a plane zone

**SAFRAN CERAMICS, Le Haillan**

Modeling and thermomechanics optimization of a HP turbine shroud

**LIEBHERR AEROSPACE, Toulouse**

Modeling of wings de-icing in aeronautics

**MBDA FRANCE, Le Plessis**

Study and optimization of metal-cased fragmentation

**PSA PEUGEOT CITROEN, Vélizy-Villacoublay**

Unsteady aerodynamics simulations

**RC FORMULA, Haller, Luxembourg**

Acquisition, analysis and data processing in car racing : why, how, and issues?

**SAFRAN AIRCRAFT ENGINES, Moissy Cramayel**

Validation of a thermodynamic model of cfm56 5c/p

The ISAE-ENSMA Career Center provides information exclusively to ENSMA students and alumni (internship and job offers, events).

► Contact : [careercenter@isae-ensma.fr](mailto:careercenter@isae-ensma.fr)

# THE NETWORKS



## THE ISAE GROUP

ISAE-SUPAERO, Ecole de l'Air, ESTACA, SUPMECA and ISAE-ENSMA, schools of the ISAE Group, are joining forces to develop excellence in aerospace training for the engineers of tomorrow.

The ISAE Group brings together aeronautical and space engineering schools in France under a common banner, so as to increase the influence of these schools, both nationally and internationally.

Its objective is to promote training for engineers, masters, specialized masters and doctorates in the field of aeronautics and space. It also allows the development of research of excellence. The ISAE Group thus perfectly meets the needs expressed by professionals in the sector.

The ISAE Group has a privileged industrial partner: GIFAS. It also extends its scope to 3 partner schools: ESTIA, EIGSI and ELISA Aerospace.

## POLYMECA



This network facilitates foreign student exchanges and students from any of the following schools specialising in mechanical engineering to complete their third year of studies at one of the other partner schools : ENSIL-ENSCI Limoges, ENSEIRB-MATMECA Bordeaux, SEATECH Toulon, ENSIAME Valenciennes, ENSMM Besançon, ENSTA Bretagne, SUPMECA Paris, and ISAE-ENSMA Poitiers.

## PEGASUS



The PEGASUS network is the brainchild of ISAE-ENSMA, ISAE-SUPAERO and ENAC. It aims to promote aerospace studies in Europe and delivers a « Pegasus Award and Certificate » to our students speaking two languages and who's spent at least 5 months abroad.

ISAE-ENSMA is a public school from the Ministry of Higher Education, Research and Innovation, holding quality labels from CGE and CDEFI.





# A PROGRAM WITH A STRONG INTERNATIONAL DIMENSION

One of the ISAE-ENSMA's main priorities is to promote international student exchanges. An international experience is required to be graduated.

Students spend an average of 6 months abroad by :

- performing an internship in a company, a research organization or a university lab,
- participating in an exchange program from one semester to one year,
- obtaining a double degree.

In order to facilitate exchanges, ISAE-ENSMA plays an active role as a member of the GE4 (one or two semesters in the United-States or Russia...), BCI (exchange program with Québec) and PFIEV networks (program supports the training of Vietnamese students). The school also participates in international programs, BRAFITEC (Brazil), ARFITEC (Argentina) and SIAE Tianjin (China).

ISAE-ENSMA offers English-taught programs. Summers programs (4 to 6-week courses) are also offered in the area of aeronautics and space engineering, in partnership with other French schools.

- **23%** of international students (26 different nationalities),
- **55** partner universities giving the chance to many students to spend part of their studies or performing research projects in institutions worldwide (Africa, America, Asia, Europe, Middle-East),
- **13** double degree agreements.

## Examples of international internships

UNIVERSITY OF CALIFORNIA, Irvine - California : Downstream evolution of a moderately high Taylor Reynolds number, for nearly isotropic, homogenous flow

AIRBUS Germany : Coupling of an ESATAN Film Cooling Model for small Rocket Thrusters to the TMG Finite Element Thermal Solver

ITA, Sao José dos Campos- Brazil : Application of Shape Memory azilys in aeroservoelasticity

VIETNAM GREEN BUILDING COUNCIL (VGBC), Hanoi - Vietnam : Development of a Green Building rating tool for single housing



# STRONG INDUSTRIAL PARTNERSHIPS

ISAE-ENSMA has signed partnership agreements with main aeronautical and aerospace groups: Safran Group, MBDA, Dassault Aviation, Altran, Stelia Aerospace...

## THE INDUSTRY PLAYS A KEY ROLE IN THE ENSMA ENGINEERING TRAINING

Specialised courses given by industrials

Collaboration for the engineering design projects and student projects

Organisation of conferences, professional days and visits of companies

Participation to the ENSMA careers fair

The apprenticeship tax is an essential boost to guarantee the funding of the technical training



Website : [taxe.ensma.fr](http://taxe.ensma.fr)

Contact : [taxe-apprentissage@isae-ensma.fr](mailto:taxe-apprentissage@isae-ensma.fr)

## POLES OF COMPETITIVENESS

Owing to its expertise in aeronautics, aerospace, ground transportation and energy systems, both at academic and research levels, ENSMA has forged ties with two poles of competitiveness:

- The Pôle mondial AESE Midi-Pyrénées/ Aquitaine, the leading French centre of excellence dedicated to aeronautics, aerospace and embedded systems, which is backed by an industry of some 94,000 staff, which forms a community of 8,500 researchers to which the 4,000 students engineers at the French graduate aeronautical schools must be added. ENSMA, together with its partners in GEA, the Grandes Ecoles Aéronautiques, is a founding member of Aerospace Valley, the council which manages the pole of competitiveness.

- EMC2 is rooted in a historical culture of transformation and implementation of materials in Pays de la Loire. The association has around markets and key technologies, all innovation actors. Small and large companies, research organizations (including Pprime Institute), training centers (including ISAE-ENSMA) contribute to the emergence of R & D projects. Serving the French industrial competitiveness, a main objective: to strengthen the territorial ecosystem of innovation and growth, structuring and animating locally six sectors (aeronautics, naval, ground transportation, energy, boating and capital goods) in a common and transverse dimension: advanced production technology ».

## TECHNOLOGY PLATFORM

ISAE-ENSMA has developed a platform for technological transfer and innovation support, ESPRITT (ESpace de Recherche, d'Innovation et de Transfert de Technologies). Located at ISAE-ENSMA, a space of about 400 m<sup>2</sup> has been set up for offices, meeting rooms, computer rooms, relaxing areas, to welcome the people involved in technological transfer and innovation activities, and to support the development of future companies or projects from students.

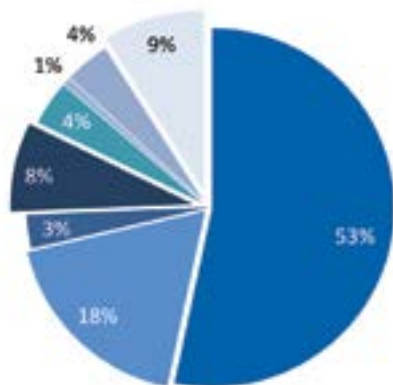


# ENGINEERING CAREERS

On average, 84% of engineers in the outgoing promotion find their first job in less than 2 months.

► Contact : [emploi@ensma.fr](mailto:emploi@ensma.fr)

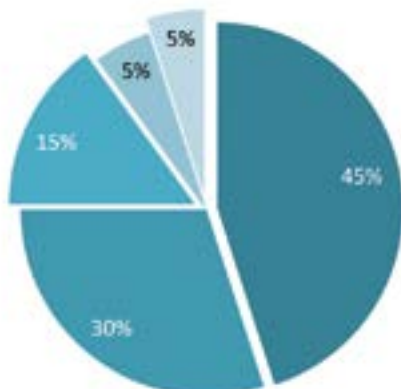
## BRANCHES OF ACTIVITY



- Aeronautics/Space/ Defense (53%)
- Consulting companies/ Design consultants (18%)
- Energy (3%)
- Automobile (8%)
- IT services (4%)
- Finance/ Insurance (1%)
- Scientific R&D (4%)
- Others (9%)

The choice of ENSMA graduates to work in aeronautics/aerospace/defense is in keeping with the wish which most students express when arriving at ENSMA.

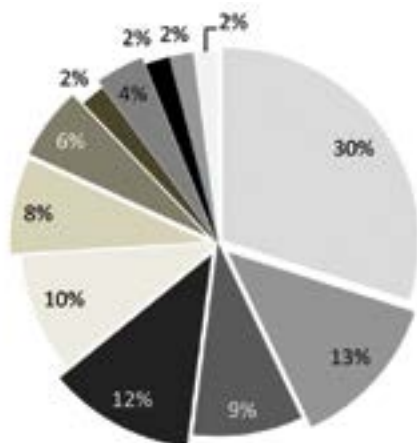
## SIZE OF THE COMPANIES



- > 5000 employees (45%)
- 250 to 4999 (30%)
- 50 to 249 (15%)
- 20 to 49 (5%)
- < 20 employees (5%)

On average, more than 75% of the ENSMA graduates begin to work for large or very large companies (250 employees or more).

## TYPES OF JOBS



- R&D engineer (30%)
- Software engineer (13%)
- Consultant (9%)
- Design engineer (12%)
- Systems engineer (10%)
- Performance engineer (8%)
- Project manager (6%)
- Production engineer (2%)
- Test engineer (4%)
- Business manager (2%)
- Quality engineer (2%)
- Others (2%)

At the beginning of their careers, a large part of ENSMA engineers work in engineering design.



# ENSMA ENGINEERS TESTIMONIES

**Caroline AUSSILHOU**  
(Class of 1996)  
*Launcher Protection of Ariane 5  
Launch Complex Manager  
CNES*



I had the opportunity to join ENSMA in 1993. During my 3 years there, I greatly appreciated the training I received, which was both comprehensive and geared towards aeronautics, and which combined theory and practice. Furthermore, as ENSMA makes a point of offering its students the possibility to study abroad, through exchanges with foreign universities, I was able to complete both my third year of studies and my graduation project in Melbourne, Australia. This was a great springboard for my career. When I came back at the end of 1996, I had no difficulty finding a job and was hired by IBM France, in the awesome world of microelectronics.

However, I could not long let go of my passion for « flying objects ». In 1999, I joined the Centre National d'ETudes Spatiales, as a member of the department of Ariane Launchers and took part in the development of the new European launcher, the heavy model of Ariane 5.

**Céline COUQUET**  
(Class of 2000)  
*Engine engineer  
Head of adaptation project  
RENAULT*



In 1993, I went to university and obtained a Master of Mechanics, a 4-year degree in mechanics from the University of Poitiers. This qualification enabled me to be admitted to ENSMA, through a special admission system, in 1998.

I chose to specialize in energetics and combustion in my third year and complement my training with a postgraduate advanced research degree in combustion within the Combustion and Detonation laboratory.

When I was 13, I decided that I would work on engines and have never changed my mind since. Aeronautics and automobiles have always been my two passions. It was then a matter of choosing the appropriate study path. ENSMA helped me make my dream come true.

I graduated in September 2000, and then joined the Renault facility in Lardy which specialises in the development of the brand's engines. Early 2001, a position



as test engineer for single-cylinder engines and combustion was made vacant at Renault Sport in Vitry-Châtillon

**Chantal GRESILLION**  
(Class of 1981)  
*Director of Lean & Progress  
SAFRAN AIRCRAFT ENGINES*



After graduating from ENSMA in 1981, I started my career as a Structural Design Engineer successively at Aérospatiale, Dassault Aviation and then Safran Helicopter Engines (Turbomeca).

I then moved on to various positions at Safran Helicopter Engines in Bordes. First as ARRIUS technical engineer, then project manager ARRIEL (turbine engine for helicopters), before taking on hierarchical responsibilities: Head of the Expertises department and then Head of the Materials Processes and Expertises department. Later I assumed responsibility for the Combustion Industrial Competence Center, a great team story that successfully transformed a moribund workshop into an example of performance with drastic improvements in quality, costs and cycles. Alongside this position, I was also a career advisor for the Industrial Manufacturing Department: mostly solicited by women, I became aware of the need for mentoring of my colleagues. From 2011 onwards, the Direction progress Approach was a significant experience: the organization of a «social weighing» and the animation of the ComEx for the restoration of weighing and the construction of the action plan that resulted.

In 2014, I joined Safran's headquarters in Issy-les-Moulineaux as Project Manager and moderator of the Group Progress Steering Committee. Two years with a very clear objective: to organize the synergy within the Group in terms of progress so that each company benefits from it and thus improves its performance and competitiveness. And since March 2016, I am Director of Lean & Progress of the Industrial and Supply Chain Department at Safran Aircraft Engines in Evry Corbeil. It is to put at the service of the company my technical experience, production and progress to meet the enormous stakes of the company, in particular the rise in cadence of the engine LEAP, successor of the CFM56: a beautiful recognition and an opportunity full of challenges !

**Julien HENRY**  
(Class of 1983)  
*HR Manager - India and the Dassault Skill Academy  
Direction of Human Resources  
DASSAULT AVIATION*



After my engineering internship in Dassault Aviation, I have thus found back this company on the strategic matter which was going to lead to the RAFALE programme. After years of programming, simulation and tests, I've had the opportunity to join the engineering and design department on the space preliminary project where I could widen my technical skills by developing futuristic projects like systems of space transports with conventional take-offs.

After 7 years of activity as a design engineer, I therefore naturally integrated our HR manager for a responsible course in all areas relating to the development of skills whether upstream or in the company. This experience allowed me to take responsibility for the development of the Human Resources necessary for the deployment of Dassault Aviation activities in India.

In parallel, my sport career (being fruitful by the title of World Champion of Gliding in 1999) led me to get interested in engines and more particularly their individual and collective performances in sport.

I thus naturally integrated the HRD to initially take part in the development of educational tools specifically related to the activities of our airframe manufacturers and then take in charge the social communication before coming to the Head of the Dassault Aviation Employment Section.





**Jérôme CHARPY**  
(Class of 2013)  
*Specialist in stator engineering*  
MBDA France



Having followed in the third year the option «Energy» with in addition the research master «Combustion», I wanted to go towards a trade with a dominant in combustion. I was hired in the «Stato» department of MBDA Bourges Subdray at the end of the ENSMA in October 2013, as «Specialist in ramjet studies».

The courses offered at ENSMA provide a good basis for understanding and developing technical and social skills.

My various activities correspond perfectly to my expectations: design and follow-up of production of models, piloting and analysis of ramjet tests, realization of models / simulations of engine and subassemblies. In particular, I am in charge of a Franco-English project for the technical responsibility for the combustion chamber of the ramjet engine.

**Alexandre KLING**  
(Class of 2013)  
*Research scientist*  
Ames Research Center  
NASA



Passionate about aerospace for a long time, my years at ENSMA were the opportunity to develop in this field, both by its quality training, and by its extracurricular activities.

Following my graduation project, I joined the NASA Ames research center in the bay of San Francisco, by an alignment of planets: a NASA robot came to land on Mars in 2012 while my group was looking for to provide a station to model the environment around the Curiosity rover using super computers.

Even if the planetary sciences can be seen as an atypical outlet for engineering training, the parallels between my work and the core of the disciplines taught at ENSMA are obvious: my daily work combines fluid mechanics, advanced calculation methods, transfer radiative, thermodynamics and data processing. The exploration of the surface of Mars being centered on the analysis of the structure and composition of rocks by robots in operations, I also regularly return to my courses in structures and materials, which makes me appreciate the very complete technical expertise provided by the ENSMA engineer training.

**Karine GARNIER**  
(Class of 2013)  
*Aircraft Powerplant Engineer A350*  
AIRBUS



After leaving school in 2013, I did my final internship in the Combustion department of Safran Aircraft Engines in Villaroche.

I then had the opportunity to start my career at the Vernon site, which later became ArianeGroup, also in the Combustion department ... this time in rocket engines. For 5 years, I participated in the functional design of combustion chamber and gas generators, from numerical calculations to fire tests.

I then joined Airbus in 2019 to return to the aeronautical field. I make sure that the modifications made to the propulsion system are mature before they enter service.

The technical but also human background that I acquired at the ENSMA continues to accompany me throughout my professional career.



**Stéphane MIKOLAJCZYK**  
(Class of 2015)  
*Aircraft Maintenance Planner*  
Airbus & Boeing  
JET AVIATION AG (Switzerland)



Joining ISAE-ENSMA was quite obvious. Passionate about both aeronautics and mechanics, I received high-level training which enabled me to obtain my engineering diploma and Master in Aeronautical and Land Transport in 2015. Although I followed the Structures option, the generalist training of the school allowed me to discover other fields and to integrate the digital simulation teams of the Danone Research Packaging Center at the end of the school, real continuity of the engineer internship carried out in second year on optimizing the mechanical performance of water bottles (in partnership with Dassault Systèmes).

However, the image of aeronautics corresponded since my childhood to private jets. In 2016, I had the opportunity to join the Jet Aviation teams in Basel (Switzerland), as an Aircraft Maintenance Planner for the Dassault Falcon teams, then Airbus & Boeing. I am in charge of monitoring maintenance and renovation sites, from project preparation to delivery of aircraft.

ISAE-ENSMA was also a springboard for my passion for aeronautics. Thanks to the various associations of the school, I was able to carry out numerous trainings, acquire several qualifications on my airplane pilot license and become an ULM Multiaxe instructor.

# AN ENGINEERING TRAINING AT THE HEART OF A LEADING RESEARCH ACTIVITY

At ENSMA, research is a tradition.

The close relationship between the 5 research laboratories, the teaching departments and industries means that students benefit from state-of-the-art training that introduces them to the latest advances in mechanical engineering and energetics.

## THE P' INSTITUTE (UPR 3346)

600 people including 200 researchers and 180 PhD students

The 2<sup>nd</sup> most important French lab in engineering sciences

Pprime Institute (P') is a research unit specific to CNRS created in 2010 in partnership with ISAE-ENSMA and the University of Poitiers. The research activities mainly concern Engineering Sciences and Physics of Materials.

P' is composed of six laboratories in combustion and detonation, aerodynamics, heat transfer, mechanics and physics of materials and mechanical engineering.

A technological platform called the CEAT (research center in aerodynamics and heat transfer), from the University of Poitiers and ENSMA, gathers heavy research facilities as well as the facilities for the supersonic teaching of the school.

► [www.pprime.fr](http://www.pprime.fr)

## LABORATORY OF COMPUTER SCIENCE AND AUTOMATIC CONTROL FOR SYSTEMS (LIAS – EA 6315)

40 teachers-researchers and 40 PhD students

The LIAS laboratory was created January 2012 from the merger of the suite LAll laboratory (Laboratory of Automation and Applied Computer Science) and the LISI lab (Applied Computer Science Laboratory).

Although the laboratory is anchored in the Communication Systems community for the fundamental aspects, the LIAS, through its applications, is naturally open to the engineering sciences either for the new modes of propulsion, energy management, water treatment, complex systems modeling, or the optimization of real-time systems. The complementarity of the automatic control, electrical engineering and computer science disciplines is an added value for the application processing, all related to engineering.

The LIAS is composed of three teams: data and models engineering, embedded real-time systems and automatic control & systems.

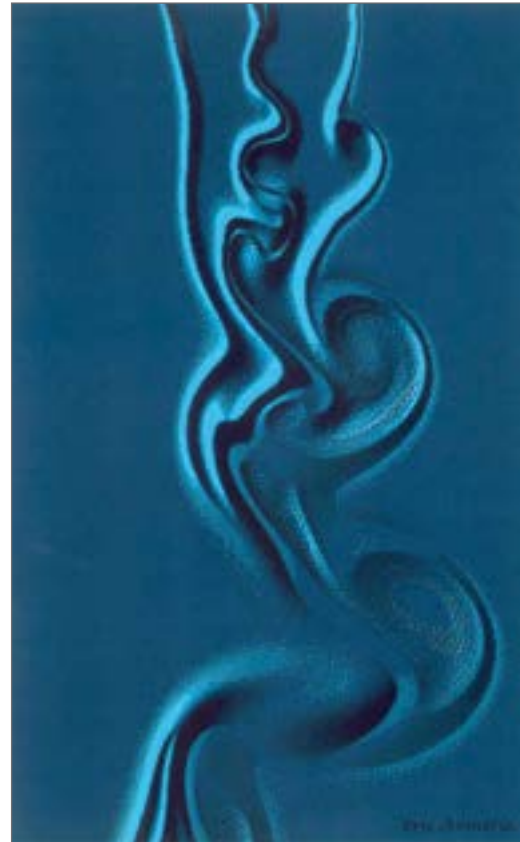
► [www.lias-lab.fr](http://www.lias-lab.fr)

# THE P' INSTITUTE

## THE THERMAL STUDIES

The purpose of the laboratory is to understand, predict and measure the heat transfers –by convection, conduction or radiation- in solids, fluids, heterogeneous and diphasic media. The main research specialities of the laboratory are natural and mixed convection, aerothermics, and radiation. A novel subject, micro and nano heat transfers, is being researched too.

The laboratory also specializes in applied research for sectors such as the aeronautical, aerospace, transport, food-processing, energy and environmental industries. Thermal sciences are increasingly concerned with the physics of coupled transfers and interact with other disciplines such as electromagnetism, mechanics, chemistry, biomechanics and nanotechnologies and the many implications they have in numerous systems.



Direct simulation of a mixture of 2 vertical jets at different temperatures

## THE COMBUSTION AND DETONICS

The mission of the laboratory is to conduct basic research on combustion phenomena (flames, reactive turbulent flows, detonations and combustion chemistry), stock propagation in solids and transfers in porous media.

Concurrently, the laboratory develops applications in the fields of propulsion, the safety of industrial facilities and industrial processes, as well as in environmental protection. The laboratory had forged strong links with industry and large organization in the energy and defence areas.



Vulcain 2 - Snecma Groupe Safran

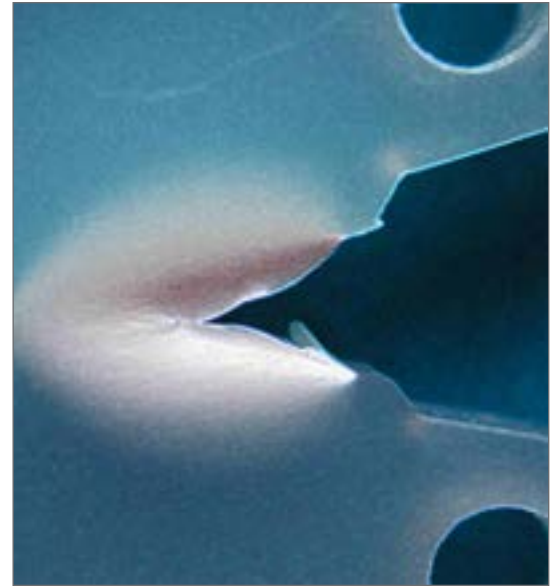


# THE P' INSTITUTE

## MECHANICS AND MATERIALS PHYSICS

The purpose of the laboratory is to conduct fundamental and applied research into the behavior and the durability of materials tested at different temperatures, in different environments and under different stresses. The emphasis is particularly placed on studying the interaction between the mechanical behavior, the microstructures and the fracture mechanics of specific materials as well as on setting up behavioral laws and performing structural analyses.

Different types of advanced materials (metal alloys, polymers, laminates, ceramics) are studied in their environment by diversified tests (fatigue, flow, heat ageing, shock absorption) coupled with observation methods at different scales and through analytical and numerical modelling. French and Pan-European research programs are developed on these topics in partnership with the transport industries (aeronautical, ground and maritime transport) and the energy sector.



Polypropylene crack - Fabienne Touchard

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## AERODYNAMICS

The laboratory specializes in fluid mechanics (gases and liquids) at low and very high velocities (super and hypersonic flows). In addition to numerical and experimental studies, research is also done on new theories.

The laboratory tackles issues related to aerodynamics, turbulence, flow control and aeroacoustics, which apply to terrestrial, aeronautical and aerospace transport systems. The laboratory is a key participant in a series of French and Pan-European research programs supported by the industries mentioned above. At The laboratory, wind tunnel tests are conducted and other specific test beds are set up for research.



Fan of the concrete wind tunnel



### COMBUSTION OF INNOVATIVE PROPELLANTS FOR SPACE PROPULSION- PERGOLA (P' COMBUSTION)

In order to study new storable propellants for rocket engines (lower risk for the user and reduced impact on environment), the Pprime Institute and the CNES are associated to develop a new set on an experimental scale allowing to characterize precisely the combustion of new propellants under pressure, both in terms of ignition and stability of the combustion stability, as well as the propulsion production.

### SUPERSONIC AERODYNAMICS (P' AERODYNAMICS)

Study in supersonic wind tunnel on models at simplified and small-scale: force channel, shock display, reduction of sonic bang... Numerical simulation of supersonic flows around simple bodies. Optimization methods for the drag reduction (collaboration with ONERA).

### SUPER ALLOYS: HIGH TEMPERATURE CONSEQUENCES

#### (P' MECHANICS AND MATERIAL PHYSICS)

These studies, managed in partnership with SNECMA Moteurs and TURBOMECA, relate to the durability of Nickel-based, mono- or polycrystalline super alloys, for turbine wheels. The purpose is to control the super alloys ageing in extreme temperature conditions and to evaluate the impact on the residual maturity in fatigue, flow and fatigue-flow.

### HEAT TRANSFERS IN AERONAUTICS

#### (P' THERMAL STUDIES)

The cooling of aircraft engines is studied by techniques such as: film cooling, jet impingement, multi punchings.... These studies are managed in partnership with SNECMA-Engines (SAFRAN Group), and also lead to European collaborations (ICTB2).

### EXCHANGE BETWEEN CAD SYSTEMS

#### (LIAS)

The laboratory is the source of a data model to allow exchange between heterogeneous CAD systems, CAD model libraries of standard components.



# ENVIRONMENT

Located on the Futuroscope site, 12 km away from Poitiers, the new buildings with a futuristic architecture allow the students to progress in a highly technological environment.

A large number of apartments (CROUS, HABITAT 86... for one, two or three persons with eligibility for housing allowance) and restaurants (university restaurant, brasserie, snack, pizzeria, saladerie...), two banks, a post-office, two bakeries and two shopping centers enable the students to line on campus.

A bus service provides a regular link with Poitiers. The exit "Futuroscope" links the site to the Paris-Bordeaux highway (A10). The Futuroscope train station is a 10-minute walk from the school.



## SPORT AT ISAE-ENSMA

Sports and physical activities have always been part of the school's curriculum. It gathers students from the three years. Among the many possible activities let us quote:

- Collective sports : basketball, soccer, rugby, handball, volleyball...
- Individual sports : climbing, body building, tennis, swimming, badminton, cross-country race, athletics...

For all these activities, supervised by teachers, the school has exceptional facilities at its disposal :

- a gymnasium with 3 tennis courts, 10 badminton grounds, wall and artificial structure climbing ;
- a body building room ;
- 4 outside tennis grounds ;
- 1 soccer and rugby ground.

Tournaments are organized every year :

- within the framework of the FNSU (National Federation of University Sports),
- for more than 50 years with the 3 aeronautics schools of Toulouse (ISAE, ENAC), and with some European universities.



# THE SCHOOL LIFE



Student life at ENSMA is livened up by about sixty associations and clubs managed by the Student Fraternity. Students can thus take part in the activity of their choice.

The different clubs:

## SCIENCES

For students who have a scientific project, who wish to design, model or size, the school provides logistical and/or financial support for the realization of these experiments:

- ENSMA Space Project, which brings together space projects such as mini-satellites, experimental rockets, stratospheric balloons, parabolic flights;
- and also: the Dassault UAV Challenge to build a hexacopter, ENSMAero for model aircraft, ENSMAsteel participates in the French Robotics Cup, ENSMArathon Shell takes up the challenge of the car which consumes as little as possible, ENSMA Junior Etudes offers to the industrialists services in the fields of competences of the school...

## SPORTS

The sport, male and female, is very present at the ISAE-ENSMA; a wide choice is offered to students. The BDS (« Bureau Des Sports », sports office) organizes events and supports the different teams:

- ENSMAIR which offers its members (conquered by the baptism of air offered to any new promotion) to learn the joys of piloting at attractive prices, and ENSMA Glider for gliding;
- And also : regatta, rowing, football, rugby, handball, volleyball, basketball, badminton, tennis, running, raid, climbing, skiing, surfing, go-karting, roller-skating, pétanque , 4L Trophy, golf, parachuting, bungee jumping ...

## CULTURE

The BDA (« Bureau des Arts », arts office) is responsible for coordinating and promoting the activities of the clubs through various events: theater, improvisation, choir, fanfare, rock, dance, pom pom, cooking, oenology, photo, cinema, video games, chess, audio-visual, comics...

## WITH HUMANITARIAN VOCATION

The CSF (« Club Sans Frontière », club without borders) contributes, through field actions, to the improvement of living conditions in certain countries of the Third World. He also participates in numerous charity events (Restos du Coeur, Téléthon) and organizes actions (air baptisms ...) for handicapped or disadvantaged people.

# A UNIVERSITY CAPITAL

GRAND POITIERS  
Communauté d'agglomération



Square Maréchal Leclerc, Poitiers

Capital of Poitou-Charentes territory, lively and dynamic, Poitiers combines with talent, quality of life (citizenship and environmental values), economic and university activity. A vast number of cultural and leisure events liven it up throughout the year and it is possible to practice almost all sports activities thanks to numerous facilities. Poitiers is naturally a very attractive city with around 140 000 inhabitants.

## THE NOUVELLE-AQUITAINE REGION SUPPORTS ISAE-ENSMA



The regional territory brings together an important aeronautical sector with 900 establishments and 70,000 jobs. To support and accompany the development of this sector, it is essential to stimulate research, technology transfer, and to train more engineers in Nouvelle-Aquitaine. ISAE-ENSMA is at the heart of these challenges to participate in the visibility, influence and growth of the aeronautical sector on our territory. The Nouvelle-Aquitaine Region therefore supports this establishment in research and training projects.

## VIENNE, THE COUNTRY OF FUTUROSCOPE



With nearly 2 million visitors a year, 1,000 employees and several thousand spin off jobs, Futuroscope has become the main axis for the development of the Vienne department. Since 1987, its expansion has relied on the presentation of new shows, developed each year, ensuring the international fame of the region.

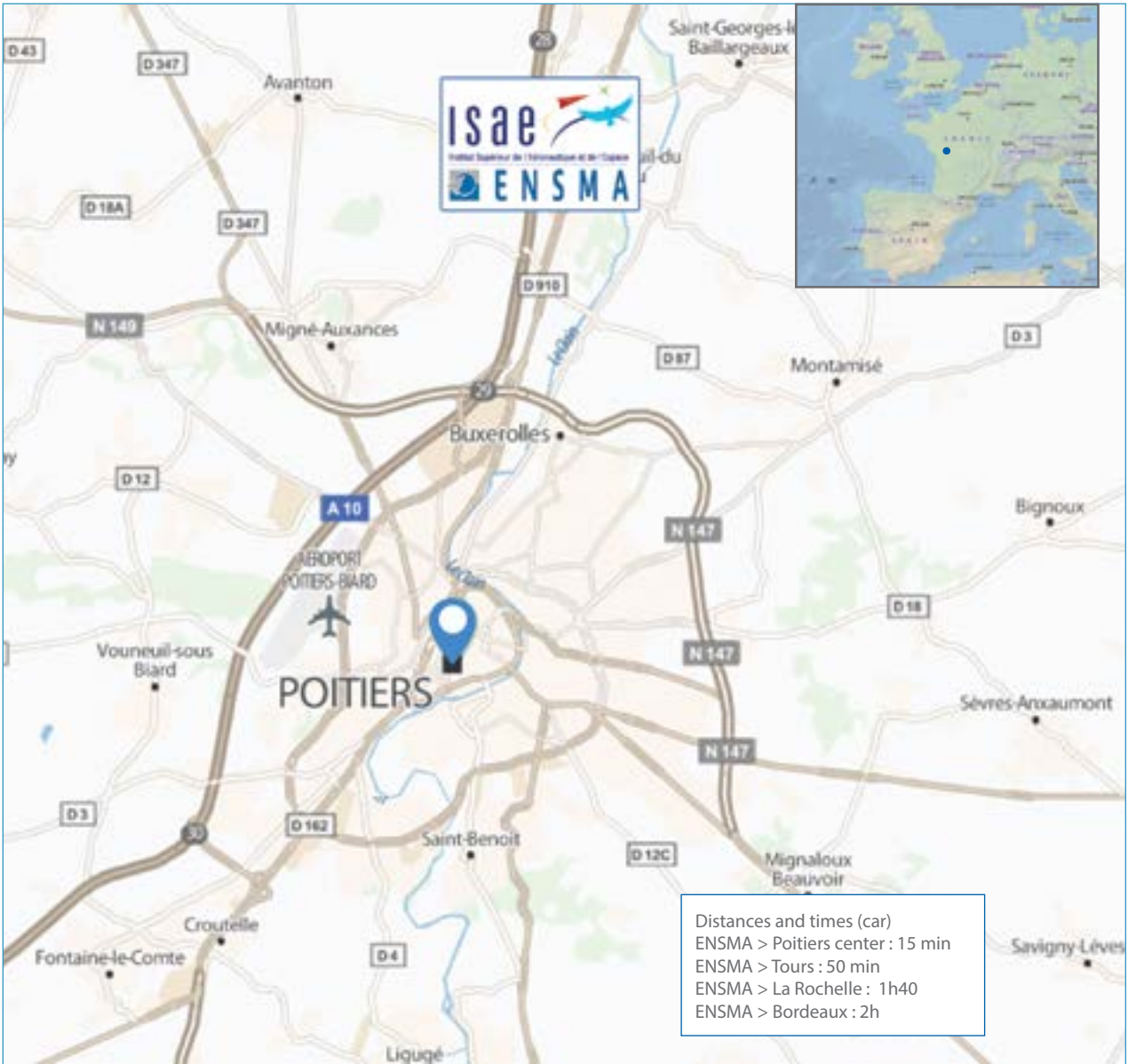
The Futuroscope Park's activity is original on the theme park market, between entertainment and educational discovery. The Futuroscope Park's mission is to entertain families and arouse curiosity thanks to the strength of emotion and imagination.



The Futuroscope park



# LOCATION



## TOMORROW STARTS HERE AND NOW!

Only 80 minutes away from Paris on the high speed train, the Futuroscope technology centre has already attracted 225 companies, 7000 employees, 700 researchers, 2,000 students and 13 research laboratories...

An original concept from the County Council, the technology centre has become a unique reference site in France, where the activities of tomorrow are starting.



Futuroscope's technology center

# ADMISSION SCHEMES

## THROUGH CONCOURS

In first year

Concours Communs INP



By preparatory classes

- Maths and Physics course
- Physics and Chemistry course
- Physics and Sciences for the Engineer course
- Technology and Sciences for the Engineer course
- Physics and Technology for the Engineer course

Through ATS (Adaptation Technicien Supérieur)

## ACCORDING TO ACADEMIC QUALIFICATIONS

Selection on the basis of student's application

1-in first year :

- for students who have a bachelor's degree (mechanics, applied mathematics, physics, electronics ...)
- for students who have a university technological diploma (specialities: Mechanical and Industrial Automation Engineering, Thermal and Energy Engineering, Industrial Engineering and Maintenance, Electrical Engineering and Industrial Computing, Science and Materials Engineering, Mathematics and Physics).
- for students who have a Bachelor's degree in « Sciences and Technologies » from the University of Poitiers.

2-in second year :

- 1st year Master students (specialization: mechanics, physics, mechanical technology, mechanical engineering, materials engineering).

## THE SELECTION OF STUDENTS

Among the students of a class :

- 80% have followed preparatory classes (concours communs polytechniques)
- 10% are selected according to their academic qualifications in first year
- 10% are selected according to their academic qualifications in second year.



## AWARDED DEGREES

ENSMA engineering degree



Students have also the opportunity to get a double degree : the ENSMA engineering degree and a degree from the following partners:

- Schools from POLYMECA (ENSMM Besançon, ENSIAME Valenciennes, SUPMECA Saint-Ouen, ENSTA Bretagne Brest, ENSIL-ENSCI Limoges, ENSEIRB-MATMECA Bordeaux, SEATECH Toulon)
- Schools from INSA Group (Centre Val de Loire, Lyon, Rennes, Rouen Normandie, Strasbourg, Toulouse)
- Arts et Métiers
- INSTN (CEA Saclay and Cadarache)
- IAE (Poitiers)
- Schools from POLYMECA
- ETSIAE Madrid (Spain)
- University of Sevilla, ESI (Spain)
- Institutes of Hanoi and Hô-Chi-Minh-Ville (Vietnam)
- IIT Chicago (USA)
- ETS Montréal (Canada)
- Politecnico di Milano e Torino (Italy)
- University of Naples (Italy)
- NUAA Nanjing (China)
- SIAE Tianjin (China)
- UFU Uberlandia (Brazil)
- ITA Sao José dos Campos (Brazil)
- University of Cranfield (United Kingdom)

Masters of science (english-taught)

- Aeronautical Mechanics and Energetics (AME)
- Turbulence

Masters in cooperation

Together with the University of Poitiers, ENSMA offers Masters and PhD programs.

These degree programs are closely linked to research laboratories that gather 250 CNRS researchers and teachers.

- Air and Ground Transportation
- High Performances Materials Engineering and Sustainable Development
- Embedded Computing

Apprenticeship training

Engineering degree in Aeronautics and Space from CNAM (apprenticeship), in collaboration with ISAE-ENSMA and in partnership with Aeroteam.

# CONTACTS

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ISAE-ENSMA

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# PRIVILEGED PARTNERSHIPS WITH COMPANIES

**AIRBUS**

Commercial Aircraft, Helicopters, Defence, Space

**SAFRAN**

Safran Aero Boosters, Safran Aircraft Engines, Safran Ceramics, Safran Electrical & Power, Safran Electronics & Defense, Safran Helicopter Engines, Safran Identity & Security, Safran Landing Systems, Safran Nacelles, Safran Transmission Systems



ENSMA has developed strong and long-standing links with industry in terms of internships and recruitment, and has also increased the participation of professional guest speakers in the academic activities (courses, engineering design projects), the meetings between the students and the companies (plant tours and presentations, lectures, round tables, career and student fairs), the presence of industrials in ENSMA's board meetings (board of directors, academic activities and research councils), the apprenticeship tax fund raising...

THANKS to our industrial partners!

