

Essential 2021

Annual report



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A WORD FROM THE CHAIRMAN OF THE BOARD



Charles Champion

2021 was a crucial year for ISAE-SUPAERO for several reasons.

First and foremost, the Institute has demonstrated its ability to conduct all its missions safely, in a highly evolving health context.

As such, and on behalf of the Board of Directors, I would like to thank the students and staff for their commitment and resilience.

Thanks also to the Foundation and ISAE SUPAERO ENSICA Alumni for their unwavering support.

Then, 2021 saw the concrete implementation of the Institute's sustainable development strategy around its three strong focuses: contributing through training and research to the ecological transition of the aerospace sector, training students to participate in the citizen debate and continuing the decarbonization of the campus.

I would like in particular to mention the publication last September by the Institute of the first "aviation and climate repository" summarizing all the knowledge on the subject, in order to help to objectify the debates and, above all, help decision-makers to define priorities for the future.

I would also like to emphasize the responsiveness of the ISAE-SUPAERO teams, thus enabling significant funds to be obtained as part of the recovery plan to continue modernizing the campus.

Finally 2021 was the year of finalization of the next COP, Contract of Objectives and Performance, covering the 2022-2026 period.

This contract was co-developed with all the stakeholders of the Institute, taking into account the contributions of students, and with a strong involvement of the Institute's staff and management. The working groups also included the Alumni, the Foundation, Industry and, of course, Trusteeship, thanks in particular to the commitment of the members of the Board of Directors. Thanks to all.

The Institute's "raison d'être" has been reinforced and it should be recalled that the COP also serves to ensure coherence between missions, objectives, roadmaps and all associated means for the coming years.

Aeronautics and Space are part of tomorrow's world, as demonstrated by the enthusiasm of airlines for the latest generation of eco-efficient aircraft, the numerous developments of electric flying platforms, the unprecedented effort on new energy sources including hydrogen, the development of new launchers, new constellations of satellites, the "Newspace"... and it is not without great pride that we saw in 2021 an ISAE-SUPAERO alumnus, Thomas Pesquet, take the command of the ISS, the International Space Station.

Finally, the Institute, through training,

research and innovation, remains a key player in Defense, a guarantor of our sovereignty and freedom.

But excellence also means diversity in recruitment, the encouragement of talent from diverse social backgrounds and openness to international markets.

The actions launched bear fruit. Foreign students are here despite the health context, the new apprentice program is a success... It is a long-term effort that we will continue.

Our society is constantly challenged by climate change, social cohesion and the pandemic context.

Thanks to the commitment of all stakeholders, ISAE-SUPAERO will continue to be an essential and inescapable player of tomorrow's world.

”

... contributing, through training and research, to the ecological transition of the aerospace sector, training students to take part in the citizen debate and continuing the decarbonization of the campus.

A WORD FROM THE PRESIDENT

After 2020, marked by the outbreak of Covid, we hoped that 2021 would be the year of the end of the pandemic. This was not the case, and health constraints still weigh on the Institute's activity at the beginning of 2022. After having acted quickly in 2020 however, the Institute, like society as a whole, has adapted to continue and develop its activities in this new context. Our training, research and innovation activities have been growing compared to the pre-Covid years. And we have prepared for the future by collectively developing the new Performance and Objectives Contract, which sets out our main directions for the 2022-26 period.

Training

Like last year, students have been has numerous to apply despite the continuing air transport crisis. We have recruited more than 800 young people with high potential in our various programs in French and English, including 40% foreigners from some 60 countries, and have maintained in France our rank as the 5th engineering school in the national entrance exams.

The ISAE Group's master of engineering by apprenticeship, which we opened last year, confirmed its success by running at full capacity in Toulouse and also deploying to ISAE-ENSMA in Poitiers.

We have also published 6 courses in English on Coursera, the leading global MOOC platform.

Research

Already highlighted by the 2019 HCERES audit, the dimensional change of our research activity was again confirmed in 2021. As last year, we registered more than €10 million

in new orders (contracts and research chairs) and published nearly 200 scientific articles – twice as many as five years ago, four times as many as ten years ago.

Innovation

We are pleased to have been able to reopen our InnovSpace, a place of innovation at the heart of our campus, in September 2021. We support a growing number of start-ups, such as our Hinfact or U-Space spin-offs, or companies created by students or alumni such as Diodon Drone, Beyond Aerospace or Ascendance Flight Technology.

Sustainable development

We are resolutely implementing the Horizons roadmap, validated at the end of 2020, which formalizes our strategic commitment to sustainable development, and in particular to the ecological transition of aviation. In 2021, we strengthened our training offer, launched a new phase of our Mermoz hydrogen-powered drone project, and brought together 8 partners around our Institute for Sustainable Aviation ("ISA") initiative. At the beginning of the year, we published our "aviation-climate repository", summarizing scientific knowledge regarding the impact of aviation on the climate, to provide a solid factual basis for the debate on the future of aviation. We have also initiated significant work to improve the energy efficiency of campus buildings.

COP 2022-26

Finally, we have worked with our trusteeship and our Board of Directors to develop our 2022-26 objective and performance contract. The outcome of the COP, which is coming to an

end, highlights the extent to which the Institute's activities have developed over the past five years, in terms of training, research and innovation. On this basis, the new COP reformulates our *raison d'être*, confirms our ambition of global leadership in higher education for aerospace engineering, and sets us 4 main objectives, with a new focus on the impact of our activities on society and the aerospace sector.

Over the course of a once more disrupted year, ISAE-SUPAERO was able to stay the course despite the health and aeronautical crises. It is therefore with confidence that we begin 2022, in a context that should be clarified, and that we mobilize around our *raison d'être*: "to train high-level scientific, humanistic and innovative engineers around the aerospace challenges, able to master the complexities of the challenges of tomorrow's world, in order to keep Europe's aeronautical and space industry and research at the forefront of the world".



Olivier Lesbre



*...we have prepared for the future
by collectively developing the new
Performance and Objectives Contract,
which sets out our main directions for
the 2022-26 period.*

The 2022-26 Objective and Performance Contract

Our raison d'être

To train high-level scientific, humanistic and innovative engineers around the aerospace challenges, able to master the complexities of the challenges of tomorrow's world.

We are committed to this mission to keep Europe's aeronautical and space industry and research, both civil and military, at the forefront of the world. We are thus contributing to French and European sovereignty and prosperity, as well as to the progress of humanity.

Our ambition for the next five years

To strengthen our position as an international leader in advanced training in aerospace engineering by asserting ourselves as a major player in civil and military aerospace sector transitions.

Major objectives

To achieve our ambition, four main objectives are set:



To contribute to the progress of society by enhancing the impact of our training and research activities.



To be a major player in civil and military aerospace sector transitions: decarbonization, NewSpace, innovation...



To further leverage our partnerships and networks to increase the impact of our activities.



To develop our fundamentals to ensure the future.

ISAE-SUPAERO CREATES THE CAMPUS OF TOMORROW

With a National Recovery Plan funding of €11.90 M, in 2021 ISAE-SUPAERO commissioned energy improvement work on the entire campus, along with studies for the major rehabilitation of the shell of 3 of the main campus and sports complex buildings. Work on these buildings will begin in January 2022.

The long-term goal is to achieve a higher level of energy performance, a more sustainable campus and an improvement in the comfort and architectural quality of the campus.



HUMAN RESOURCES

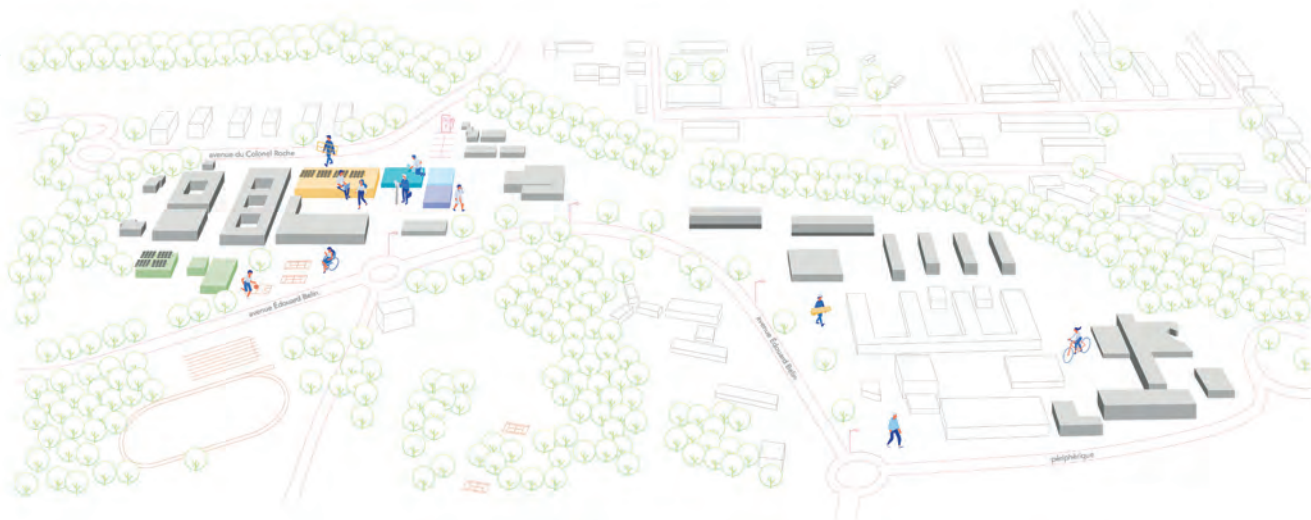
Nearly **1,900** students enrolled
more than **800** new recruits in 2021,
including **40%** international students

Workforce of **610** people, including
122 teacher-researchers and engineers

FINANCE

Total budget: **€65 M**

€38.60 million subsidy
for public service charges



Snapshots of the year

Graduation of engineers class of 2020

Due to sanitary conditions, the graduation of the 2020 engineering class was held in June 2021, on our campus, in a hybrid and intimate format for the 301 graduates.

Nicolas Maubert (S2001), Counselor for Space at the French Embassy and representative of the French Space Agency (CNES) in the United States, was the patron of this class.

The Great Witness was Pierre-Éric Pommellet. (S1989), CEO of Naval Group.

My Shell

My Shell is an innovative exploratory project (IEP) to study the feasibility of a startup led by 4 Master's students specializing in Innovative Project Management and Entrepreneurship (MGPIE).

The idea is to make a folding and aesthetic helmet, to convince the 50% of users of two-wheel vehicles (bicycle, scooter, etc.) who do not wear them.

The team focuses on customizing the helmet via an online platform, using a non-Newtonian material to improve shock absorption, LED strip integration for light safety and proximity to their future customers.

Alumni, did you say entrepreneurship?

Promoting ISAE-SUPAERO alumni entrepreneurs was the objective of these portraits exhibited for several months on campus. From aeronautics to sustainable development via learning, technological innovation has been praised through the dissemination of these entrepreneur portraits.



Snapshots of the year



A message from the ISS

Thomas Pesquet, French astronaut and ISAE-SUPAERO alumnus (S2001), sent a message to our students from the European Columbus laboratory of the ISS last June. Thomas first talked about his time at the Institute as well as his role in the ISAE-SUPAERO social outreach program. Above all, he wanted to remind us that our future engineers, united around the same passion and responsibility in the face of environmental challenges, have all the keys to meeting these new challenges.



Open Day, the emotion of discovery

An edition punctuated by encounters, discoveries and conviviality.

2,000 visitors attended our campus to learn about our training, research departments, projects and state-of-the-art equipment. 245 people, both students and staff, welcomed visitors, presented animations and practicals and led conferences to recruit new talents.

Snapshots of the year

Graduation of the class of 2021 engineers

330 engineering students, 61 of them international, graduated on 4 December. A ceremony still constrained by sanitary conditions, but which had the honor of benefiting from the presence and informed advice of Éric Dalbies, Grand Témoin & Deputy Managing Director of R&T and Innovation of the Safran group, Isabelle Rongier (S1988), Deputy Technical Director of Space Transport Systems at CNES and François Decourt (S1993), Deputy Director of the AIA of Cuers-Pierrefeu, patrons of the class of 2021.



2021 Master's degree ceremony

Look back at a face-to-face and large format Master's ceremony on 3 December to award the diplomas to 255 students, including 131 international students, representing 34 nationalities, reflecting the international attractiveness of these programs of excellence.



Corporate Village

The Corporate Village, a must-see event for our students and partners, brought together more than 500 students and 80 recruiters from 30 companies this year. It was once again the occasion for numerous meetings and exchanges between companies and future candidates from ISAE-SUPAERO.



3
third
in the change
ranking NOW



The Aviation-Climate Repository and the CAST tool resonated outside the walls of the Institute. On the one hand, CAST has been the subject of numerous press articles and has aroused the interest of several industrialists. On the other hand, the co-authors of the Repository have been presenting their reports for several weeks to industrial partners (Airbus, Safran, AirFrance), to various French institutions (Region, Directorate-General for Energy and Climate – DGEC, ADEME) and to civil society (Air and Space Academy, Greenpeace).

The Horizons strategy and these two projects allow the Institute to make its academic contribution to the ecological transition of the aviation sector!



Our commitment to the ecological transition

The ambition of the “Horizons” roadmap launched in January 2021 is to integrate environmental issues at the heart of the Institute’s global strategy. This touches on the transformation of curricula, research and campus. The roadmap is now included in the COP 2022-26. This mobilization was recognized by a third place in the *ChangeNOW* ranking of the engineering schools most committed to the ecological transition.

Focus on Aviation-Climate topics:

The ISAE-SUPAERO Aviation-Climate Repository, the result of the work of five researchers and the Institute’s head of sustainable development, was published last October. The purpose of this report is to provide scientific evidence useful for understanding the links between aviation and climate and for building informed opinions on these issues, as objectively as possible. It was subjected to a specific review process, integrating both ISAE-SUPAERO staff and external researchers from different institutions. This document takes the form of a 216-page report and is supplemented by a 16-page summary.

The CAST (Climate and Aviation - Sustainable Trajectories) tool, whose initial version was published online at the beginning of the year, is a tool for simulating and assessing aviation climate trajectories in the form of a web application accessible to all.



Aviation
and climate
repository



CAST

Environmental issues at the core of our commitments

ISAE-SUPAERO is committed to the annual measurement of its carbon footprint, with the objective of achieving a 25% reduction in emissions by 2026 compared to 2019. With the launch in 2021 of energy renovation work on buildings, 67% of thermal energy savings are targeted. A transition approach impacting our three pillars..



EDUCATION

- Creation of a 20-hour module for all engineering students on socio-ecological issues
- **16** courses dedicated to environmental and social issues
- **31.5** ECTS corresponding to courses on environmental impact
- Creation of a training module for ISAE-SUPAERO staff on socio-ecological issues.



RESEARCH

- Creation of ISA (Institute for Sustainable Aviation)
- 50 researchers and PhD students are working on transition topics
- Aviation and Climate repository
- 3 chairs: CEDAR, ISAAR, AEGIS



INNOVATION and PROJECTS

- Mermoz drone
- CAST tool
- 3 student associations: SUPAERO 4 Earth, Club Meca, Rêve'Ailes
- Dedicated events: Climate fresco, Low tech activities

Corporate Social Responsibility (CSR)

In 2021, ISAE-SUPAERO confirmed its commitment to diversity and inclusion. The year saw the deployment of its 2021-2023 action plan for professional equality between women and men.

It was also marked by the formalization of the system to combat sexual harassment, sexual and sexist violence and discrimination of all kinds (HDVS) with the definition of a protocol for processing reports of HDVS acts, the establishment of a reporting platform for deployment in 2022 and a collaborative

reflection for the establishment of a charter against HDVS acts.

Finally, the Institute has started to implement its Disability Action Plan 2021-2023, resulting from an agreement with the Fund for the Integration of People with Disabilities in Public Service (fonds pour l'insertion des personnes handicapées dans la fonction publique - FIPHFP) signed in January 2021 and has actively participated in the European Week for the Employment of People with Disabilities (duoday, conference, posters, etc.).



A photograph of a computer lab with several students wearing face masks and working on their laptops. The students are focused on their screens, which display various technical diagrams and data. The lab has large windows in the background, letting in natural light. The overall atmosphere is one of professional and academic diligence.

OUR FOUNDATION

“Excellence passionately” is our motto. Since 1909, working closely with the aeronautics and space industry, excellence has been our heritage, our foundation and our ambition. It is at the core of our activities, our fields, our professions, that we cultivate and instill this desire for perfection.



Training

ISAE-SUPAERO engineering course

330 graduates in 2021 including
60 international

34 graduates took a Research Master's
along with their 3rd year

29 have a double competence outside science
and engineering, validated by a 2nd diploma of
excellence (London School of Economics, MSc X-HEC
Entrepreneurs, Sciences Po, HEC, etc.)

1117 engineering students and apprentices
at the beginning of the 2021 school year:

154 joined the curriculum as part of a
Double Diploma

56 students were studying for a double
degree in partner institutions

Despite the health crisis, **157** left for academic
mobility or did an internship abroad in 2021.



40% of girls
in the 2nd class of
apprentices



A very good level of recruitment in 2021 despite a difficult context

Recruitment into both conventional and apprenticeship engineering courses did not suffer from a difficult context between the aeronautical crisis and uncertainties related to the health context for foreign candidates. Thus, 372 students and 30 apprentices joined us at the beginning of the school year, with a level of recruitment as demanding as before.

Noteworthy:

- A record number of double degree students from our academic partnerships, with 67 international students, compared to approximately 50 in recent years, and 17 students from Sciences Po, HEC, ENS Saclay and ESPCI.
- A second apprenticeship class with 40% girls!
The 30 apprentices had also signed their work-study contracts before the beginning of July, which is a very good sign of the success of training with industrialists.



Graduation
ceremony
Ingénieur



Engineering courses

Two graduation ceremonies in 2021!

The Engineer graduation ceremony is a strong and highly anticipated event that marks the culmination of each student's journey. We were able to take up the challenge of offering two ceremonies in 2021! Indeed, due to the health situation, the graduation of the class of 2020 – which we wanted to keep face-to-face – had been postponed to July 2021. From the constraint – still present at the beginning of the summer – emerged an innovative ceremonial format. A summer version organized on campus on the theme of boarding was thus imagined: portraits of the 301 graduates exhibited behind the scenes, an intimate ceremony, centered on the course and future of the students, where graduates and relatives were invited to “board” the amphitheatres to celebrate this achievement together. In this uncertain climate, holding the event was a real challenge, both temporal and logistical, and the testimonies of the graduates attest to its success:

We would like to especially thank you for organizing our graduation ceremony on July 3, 2021 despite the obstacles encountered.

Julie and Rémy
class delegates

With this ceremony, organized despite an exceptional context, you managed to summarize, in one afternoon, all your educational process. A grand ceremony, which truly reflects the excellence of this school. A perfectly orchestrated staging with perfectly managed synchronization between the different rooms.

Julien

Thank you very much for this ceremony which is in the image of our schooling adapted to our needs and desires.

Robin

As for the **330 graduates** of the 2021 class, they graduated on December 4, 2021 on the CREPS website in an almost normal manner.

631 diplomas were awarded as required in 2021.





Master's and Mastère Spécialisé® courses

2021 Graduates

201 Mastère Spécialisé®

1 Post Graduate diploma

96 Aerospace Engineering Master's degree

Numbers

The return to school of the Master's and Mastère Spécialisé® courses took place in September, allowing us to welcome to the institute:

124 1st year Master's degree students (including 2 on double diplomas at the Technical University of Munich)

124 2nd year Master's degree students

234 Mastère Spécialisé® students

Course developments

- RNCP registration of the Mastère Spécialisé® Artificial Intelligence & Business Transformation (AIBT) course: "Project manager in Artificial Intelligence and Data Science (MS)" certification, number 35609. The registration of this certification opened this course to apprenticeship and allows us to offer 3 certificates of 84 hours, fundable by mobilizing the personal training account (Compte Personnel de Formation - CPF).
- The 2021-2022 academic year sees the emergence of new courses for the **Master's in Aerospace Engineering**:
 - **New challenges: Climate change and energy transition** common core.
 - **Soft skills for innovation** background expansion.
 - **Aviation & environments** completed with Aeronautics common core in the 2nd year.

Graduation
ceremony
Master's degree



Seen in 2021

• Hosting of the Executive Master of the Ecole Polytechnique:

Innovation in aeronautics and space module. From a professional development perspective, 36 participants were able to attend conferences on various themes such as: Drones, the future of air mobility, Neuroergonomics in aviation, NewSpace and its challenges, What innovation strategy for SMEs? The SuperCam and Rover Perseverance adventure, Virtual Reality at the service of space.

• DefInSpace Hackathon:

The first Space Command hackathon was organized by ISAE-SUPAERO in collaboration with the Centre Spatial Universitaire de Toulouse (CSUT) and UNIVERSEH.

24 hours to imagine tomorrow's space defense:

- How can the European Union appropriate space security and defense issues?
- Cloud in space: what sovereignty and defense interests for France?



Master's and Mastère Spécialisé® courses

National School of Meteorology and ISAE-SUPAERO for a new partnership

November 9, 2021:

Signing, at ISAE-SUPAERO, of the agreement with the National School of Meteorology by Mr Olivier LESBRE and Mr Philippe DANDIN.

The two institutions have agreed to work together to improve the skills of students at each institution.



- Thus, semester 9 of the IENM "Weather & climate sciences" curriculum will welcome M2 students from the ISAE-SUPAERO Master's in Aerospace Engineering
- The first semester of the ISAE-SUPAERO MS Management of Innovative Projects and Entrepreneurship (MS MGPIE) will welcome students from semester 9 of the IENM curriculum.

In parallel to this, the teaching teams of the two schools are also collaborating in the implementation of digital training on these subjects to reach a wider audience together. A partnership between two institutions to respond with their skills to the current needs of society, and their students

Mastère Spécialisé® AIBT

14 registrants inaugurated the first class of the Mastère Spécialisé® AIBT in the 2021 academic year. This first session welcomes a balanced mix of young apprenticeship graduates and active professionals, who follow courses at an alternating pace. They will attend a total of 13 weeks of lectures, primarily at ISAE-SUPAERO. 2 modules are taught by teachers from IRT Saint-Exupéry and 3 are taught by teachers from TBS Education.



Continuing education

Executive Education

ISAE-SUPAERO has continued to expand its continuing education offer and now offers

56 short modules (10-40 hours of training), **16 certificates** (40-120 hours of training) and **9 Postgraduate Diplomas**.

The courses are offered in the fields of digital technology, project management, systems engineering, aeronautics and space.

The second class of Value Driven Systems Engineering students graduated in December at a remote ceremony. This ISAE-SUPAERO executive certificate is the result of a partnership of the Institute with **Capgemini Engineering** and **EUROSAE**, which operates the training.



ECATA - European Consortium for Advanced Training in Aerospace

In 2021, only 16 of the 21 high potential recruits participated in the ABI program, despite a start postponed until August due to the pandemic. The group consisting of employees from SAAB, Dassault Aviation, Airbus, BAE Systems, MTU and Safran, worked on the subject of open innovation, applied to the European aeronautics and space industry.

After starting the session at the Technische Universität München (TUM), the session continued in Turin, on the premises of Politecnico di Torino. Finally, the participants met in Delft, the Netherlands, to finalize their work and present their results. They made their final presentation in the form of a 2-hour webinar, accessible on ECATA's YouTube channel, which gathered an audience of 450 people.

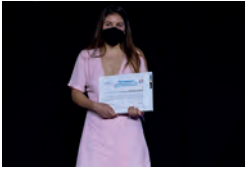


ECATA 2021 Live Webinar
The Era of Open Innovation
in Aerospace



Excellence rewarded

Award-winning students at the Master's and Mastère Spécialisé® degree ceremony on Friday, December 3, 2021:



ISAE-SUPAERO – ENSICA – Alumni Award

Award presented by Jean-Louis Marcé to

- Marion BURNICHON,
Master Aerospace Engineering – Major Space Systems
- Pablo MARTIN GOMEZ,
Mastère Spécialisé Aeronautical Engineering – Major Flight Test Engineering
- Clara MORICEAU,
Mastère Spécialisé Space Systems Engineering - SEEDS



3AF award

Award presented by Francis Guimera to

- Raquel ALONSO CASTILLA, Master Aerospace Engineering.



Dean's list

32 students (**11** in Mastère Spécialisé® and **21** in Master's degree) distinguished themselves by their remarkable academic career. The Dean's list recognizes the brilliant background of students with an overall average greater than or equal to 16/20, and a thesis mention of "excellent" or "exceptional".
Congratulations to them!



Excellence scholarships

Excellence scholarships are an important lever of international attractiveness and make it possible to attract the best international students to the ISAE-SUPAERO Institute.

These **11** excellence scholarships were awarded to **4 female** and **7 male** students by industrial and academic partners for the following programs:

MBDA: 4 Indian students and 1 Indonesian student

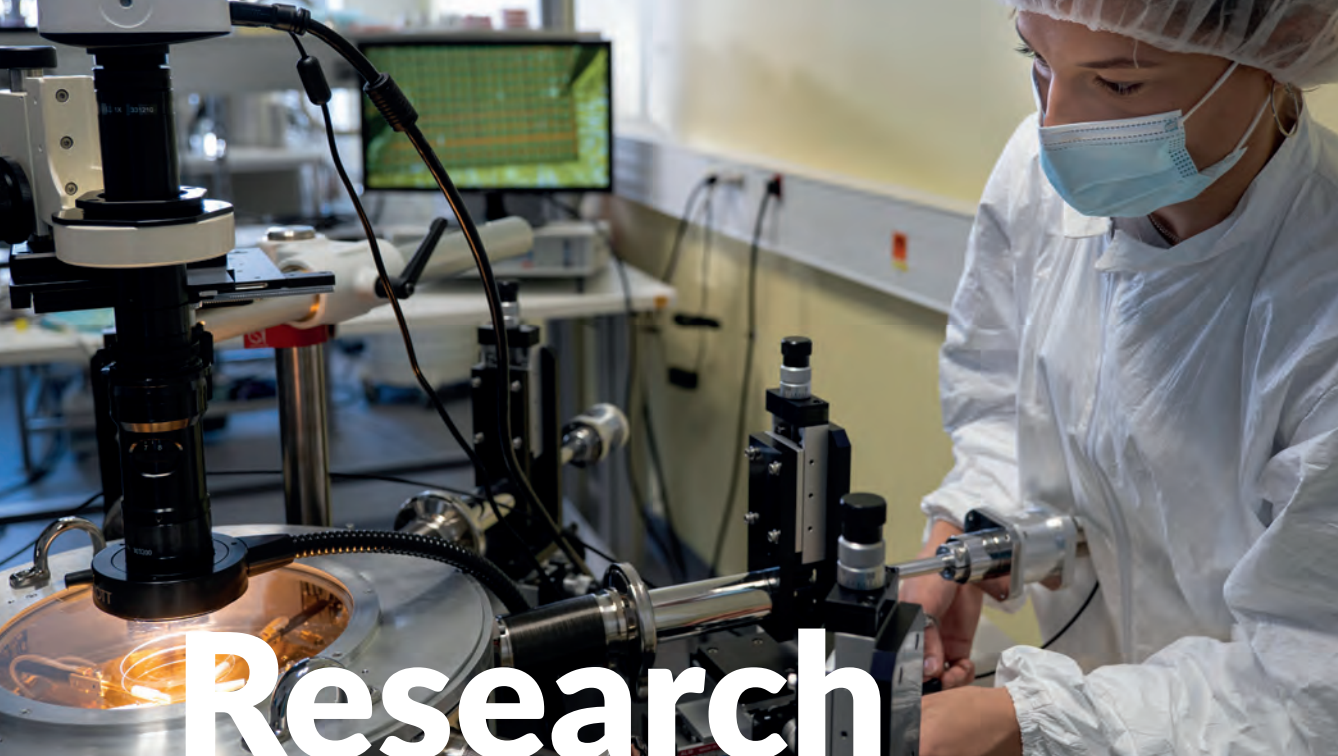
CEDAR (AIRBUS): 1 Korean student, 1 Canadian student and 1 female Spanish student

ISAE-SUPAERO Foundation: 1 Chinese student

Toulouse School of Aerospace Engineering

(TSAE): 1 Costa Rican student and 1 American student





Research

Research at the Institute is conducted with a dual mission:

- *developing scientific knowledge for the benefit of civil society, industrialists and sovereignty issues in the fields of aeronautics and space engineering;*
- *participating in the objective of excellence for all the courses taught by the Institute.*

As in the previous year, 2021 was marked by both the health crisis and the aeronautics crisis. Despite this unfavorable context, activity at the Directorate of Research and Educational Resources (Direction de la Recherche et des Ressources Pédagogiques - DRRP) was maintained at a high level, with in the first instance, the consistent support for the various training courses, despite the necessary adaptation to the circumstances by alternating face-to-face and distance learning.

Regarding research, 2021 is in continuity with the two previous years, with 175 doctoral students co-supervised for approximately fifty researchers holding the HDR (habilitation à diriger des recherches - authorization to conduct research), a high-level scientific production with 190 publications and circa € 10 million in contracts and research chairs.

In line with the Horizons roadmap dedicated to sustainable development, ISAE-SUPAERO has led two new initiatives: the drafting of a report entitled ISAE-SUPAERO aviation & climate repository and the setting up of a major multidisciplinary project entitled ISA (Institute for a Sustainable Aviation). The Institute benefits from the government's aeronautics recovery plan through 4 participations in projects set up within the framework of the Council for Civil Aeronautical Research (Conseil pour la Recherche Aéronautique Civile - CORAC) and by making available several experts from industry. 2021 also saw the commissioning of two of the Institute's major facilities: the aeroacoustic wind tunnel and the irradiation booth. In addition to these salient events, also noteworthy on a more individual scale are some examples of actions and work carried out on a daily basis in our six training and research departments. Finally, 2021 marked the end of the career of Pierre Magnan, creator of the microelectronics lab and who played a major role in the development of research at the Institute.



190
scientific
publications



Sustainable aviation: the ISA project

In 2021, ISAE-SUPAERO initiated the creation of the Institute for Sustainable Aviation (ISA). The ISA is a structure of research collaboration, without walls or legal personality at its creation. The Institute was This agreement specifies in particular the duties and operating principles of the three governance bodies of this structure: a board of directors, a steering committee and a scientific committee. This initiative has a visual identity and a protected trademark intended to establish it in the landscape of the European ESR. As such, it is highlighted in 2021 as a major initiative of ISAE-SUPAERO in the annual review carried out by ICAO on the theme Sustainable Aviation.

Located in the heart of the European aeronautical metropolis, the ISA aims to implement interdisciplinary research at the interface of social sciences and humanities, financial and industrial economics, aerospace engineering and flight operations, transport and environmental laws and regulations, energy and atmospheric physics. It aims to produce, at the highest level of recognition and academic influence, new methods and

knowledge to contribute to the scientific illumination of the process of transformation of the air transport sector towards a responsible and sustainable decarbonized aviation, with lower environmental impact.

The research programs that are being prepared concern more particularly the transformation of fleet operating rules to integrate the objectives of energy efficiency and avoidance of condensation trails, the multi-criteria evaluation of the rise of regional electric aviation, the substitution of new fuels (SAF and hydrogen) for fossil kerosene.

The ISA is a structuring initiative for the ESR Toulouse ecosystem and would contribute as such to the portfolio of projects proposed by the UFT as part of the ongoing PIA4 call for projects. This initiative has already received the support in principle of Airbus, the competitiveness cluster and the DGAC. The ISA strives to label ongoing research projects and will deploy its first own research actions in 2022 to the extent of the resources it manages to mobilize.

Recovery plan

launch of CORAC projects

INPRO

A project to improve computation methods for the integrated design of propeller-driven aircraft.

ISAE-SUPAERO contribution:

- Development and validation of simplified methods to model the aerodynamic impact of propellers installed in aircraft calculations using a body force approach.
- Predicting, through an LES approach, aeroacoustic sources related to aircraft/wing interaction.
- Modeling these aeroacoustic sources in a body force calculation.

June 2021 – Sept. 2024

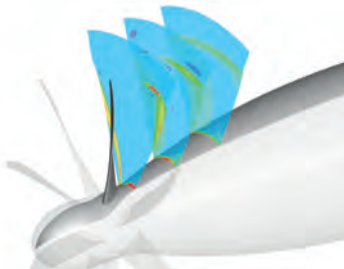
AIRBUS, CERFACS, ISAE-SUPAERO, ONERA, SAFRAN
AIRCRAFT ENGINES

TOUCANS

ISAE-SUPAERO, ONERA Salon de Provence and Airbus are partners in a CORAC "TOUCANS" project aimed at developing a new generation of automated, efficient and safer cockpits for tomorrow's air transport. The Institute is developing innovative brain-machine interface and artificial intelligence technologies to better predict human performance and optimize human-technology coupling.

These neuro-technologies at the service of aviation safety will be tested in simulators, but also in the Institute's new flying experimental platform dedicated to research in neuroergonomics.

The TOUCANS project took off in September 2021 for a period of 2 years.



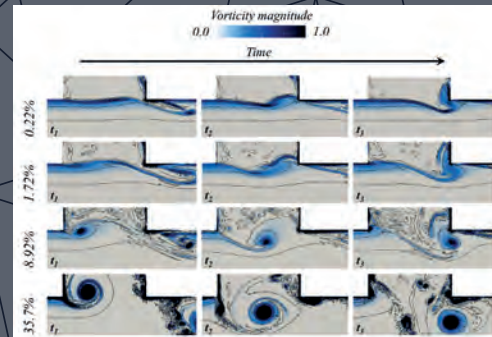
MAMBO

A project to improve computation methods for the prediction of engine and aircraft noise.

The contribution of ISAE-SUPAERO is focused on aircraft door cavity noise (whistling), in order to determine the characteristics of the turbulent boundary layer necessary to be taken into account to accurately predict this noise. We also aim to improve the injection of turbulence into the IC3 code, and to propose alternative approaches (linear/nonlinear stability).

May 2021 – Dec. 2024

AIRBUS, ARIANEGROUP, CEREMA, CERFACS, CNRS, ATTM, ENSAM, ECL, IMACS, INRIA, INSA, Sorbonne Univ., ISAE-SUPAERO, Univ. du Mans, MSC Software, ONERA, PHONOPTICS, SAE, Univ. Grenoble Alpes, Univ. Gustave Eiffel, VMICRO



PARIDES

The project for a more Decarbonized and more Sober Incremental Regional Aircraft (Projet d'un Avion Régional Incrémental plus Décarbonné) is a 2-year project led by ATR with 9 partners, whose overall objectives are:

- to reduce the environmental impact of regional transport
- to improve flight safety
- to achieve operational flexibility
- to reduce operating costs

The project includes seven flows dedicated to different technological areas. ISAE-SUPAERO participates in the new frost protection system technologies flow. The challenges are to develop a defrosting system that consumes less energy, adapt it to sources and means of electrical energy storage in compliance with the new regulations on icing.

Recovery plan

provision scheme



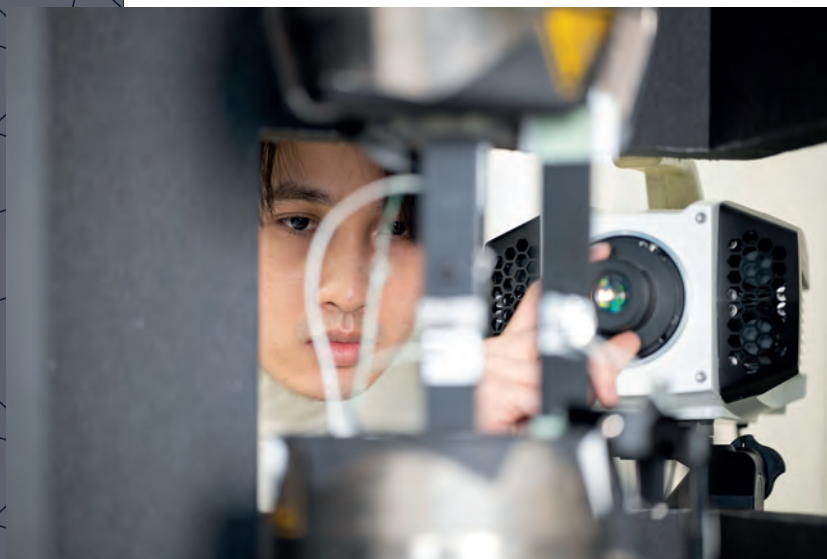
This measure, officially launched in October 2020 aims, in the context of the health crisis and as part of the France Relance plan, to keep companies' R&D staff in employment and to make young graduates and doctors available to companies. These are collaborative research contracts drawn up between a company and a public research stakeholder. For the operation of these research contracts, the State covers the remuneration of the R&D personnel engaged in the collaboration, up to 80% for most types of actions, and covers part of the costs related to the hosting and monitoring of the collaboration by the research structure. There are four types of action. Actions 1 and 2 consist in providing a company employee to a research team, while actions 3 and 4 consist in assigning to a partner

company a young graduate (master's or doctorate) hired by the research structure.

Upon publication of this call for projects, the DRRP teams mobilized in their network to use this scheme to intensify the research partnerships with our regular partners and to initiate partnerships with others. The results are satisfactory, with 7 type 1 actions, provision of an employee in our teams and one type 2 action, made available as part of a thesis, for a global funding of approximately € 540 k. The partners are Airbus (5 actions), Altran now CapGemini, Expleo and Latécoère. Other actions were not sufficiently mature to be presented in time for the call for projects, with CNIM Air Space, MCVE, Safran Nacelles and Liebherr Transportation System (LTS). However, they will be materialized in other contractual forms.

Collaboration topics are varied, but a large part addresses issues related to the decarbonization of the aviation sector and 5 of the eight are led by DMSM.

As such, two actions address the resistance to extreme conditions of metallic or composite materials in the context of their use for hydrogen tanks, or the mechanical strength of parts made by additive manufacturing. Most provisions are for a period of 24 months and were initiated between July 1 and December 31.



Large-scale facilities

Aeroacoustic Wind Tunnel (soufflerie aéroacoustique - SAA) advancement

A year marked by the beginning of fine aerodynamic and acoustic characterization, over the entire speed range, of the wind tunnel test vein which led to the final choice of the manifold. Two initial models were dimensioned. The acceptance testing model focuses on acoustics, with an open-ended design similar to a well-known test case around the acoustic problem of landing gear. The reference model is a complete system including a 2D profile and a tandem of

force measurement balances whose acceptance is estimated for September 2022. The wind tunnel has been dimensioned to carry out fundamental cavity noise projects. The full multi-year maintenance plan has also been deployed. Finally, a new data acquisition chain coupled with the wind tunnel's control systems was dimensioned. It will be progressively implemented in 2022. The wind tunnel is scheduled to go into production in the first half of 2023.



Irradiation booth

DEOS has acquired an X-ray irradiation booth of variable energy ranging from a few keV up to 320 keV. Its primary objective is to experimentally simulate the aggression suffered by electronic components when placed in a radiative environment such as space or nuclear fusion facilities. The main originality of this equipment is its flexibility of use and access to very high dose rates to reduce the duration of the tests from several months to a few hours.

It allows rapid testing of the response of new electronic technologies, such as those developed within the Institute's image sensors group, and to effectively select the most promising approaches to develop future radiation-resistant space, nuclear, scientific and medical instruments. After an initial familiarization and calibration step, the first irradiation of image sensors took place in 2021 as part of research activities.

Focus on the Directorate of Research and Educational Resources (DRRP)



NAOMI MURDOCH

Engineer – researcher in Planetology and space instrumentation on the SSPA team at DEOS.

Thanks to the SuperCam microphone, developed by the SSPA team, we were able to capture, for the first time, the sound of Mars in February 2021! These recordings open a window on previously unexplored regimes of Martian atmospheric science. Thanks to the InSight mission and its SEIS seismometer, we were able to highlight the discovery of the internal structure of Mars. These results, published in the journal Science in

July 2021, are important to understand the formation and evolution of Mars. Finally, the launch of the DART (Double Asteroid Redirection Test) mission, an unprecedented planetary defense mission in which we are collaborating, took place in November 2021.



ROMAIN GOJON

Research engineer in digital aeroacoustics at DAEP.

I am interested in the noise of flows, especially aeronautical. I am working on jet noise, cavity noise, air intake noise, and mainly on drone rotor noise with the implementation in 2021 of a complete and original approach to the problem. High-fidelity simulations of the large-scale simulation type are carried out in order to gain a fine understanding of noise generation mechanisms. Simplified models are developed and integrated into our rapid simulation tools. Particle-type fast medium fidelity simulations are

performed to find optimized rotor geometries with long endurance and low acoustic signature using genetic algorithms.

Experimental campaigns are conducted in the laboratory's anechoic chamber in order to validate the optimized geometries and to work on more complex geometries of interaction between rotors.



D. MATIGNON

Lecturer-researcher in applied mathematics at DISC.

I contributed to several scientific publications in 2021, including on numerical simulation methods that preserve the mathematical structure of physics equations used in aeronautics; this multidisciplinary theme around Hamiltonian systems with interacting ports is supported by ANR, DFG and AID.

In teaching, the Complex Systems and Simulation (SXS) field that I have set up will celebrate its 10th anniversary: this specialization of 3A will have given a taste for teaching through research to a very large number of students who started a doctorate after ISAE-SUPAERO.

Focus on the Directorate of Research and Educational Resources (DRRP)



ANIS HOR

Lecturer-researcher at DMSM.

Over the past five years, my research activity has focused on additive manufacturing (AM). I have been working on the acquisition of 2 AM devices using different technologies: powder bed fusion since 2021 and wire deposition scheduled for 2023. In parallel, this research activity was enriched by 5 co-supervised and defended theses and several regional industrial projects and with DGA. At the Clément Ader Institute (ICA), I participated in the assembly of the AM transverse axis, which I manage with a colleague from IMT-Albi and in the implementation of the ICA multi-site metal AM platform.

Currently, this platform is part of the AddimAlliance association of AM platforms of Occitanie and Nouvelle Aquitaine within Aerospace Valley. As a member of GDR ALMA, this research is now recognized and a dozen papers are published on the subject each year. These efforts were rewarded with two presentation prizes:

- Sabrine Ziri, 2nd prize "ESAFORM 2021"*
- Noémie Martin, 3rd prize "The ASTM International Conference on Additive Manufacturing (ASTM ICAM)".*



FRANCESCO SANFEDINO

Lecturer-researcher in space mechanics, modeling and robust control of flexible space vehicles at DCAS.

2021 was a rich year in terms of new collaborations and saw the start of many important research activities. Close collaboration with the European Space Agency (ESA) has made it possible to produce a new co-supervised PhD project, two research contracts and the inclusion of our tools in the agency's calls for tenders. The ENVISION mission we are working on was selected during 2021 by ESA as the reference mission for the observation of

Venus in 2030. Thanks to the invaluable support of the Institute, I was also able to begin the acquisition of equipment dedicated to the experimental validation of our research and the development of innovative solutions for the control of micro-vibrations.



BHAÏRAVI MAHADEVIA

instructor-actress-director, permanent professor at LACS, polyglot (5 languages), globe-trotter, writer in my spare hours.

I am a communication and theater coach at LACS, in English and French, and have been responsible for teaching English since 2021. In this respect, my role is to ensure a diverse and varied offer thanks to a team of individual contractors with rich and surprising backgrounds and above all passionate about transmission by maintaining a balance between rigor and pleasure in the courses and by offering personal follow-up to each student.

What particularly marked me during this year was the rapid adaptation of teaching, the support of individual contractors and the upholding of student motivation despite the health crisis. For example, the annual theater performance in English had to be canceled, representing 80 hours of unfinished work for each participant. Finally, we used this energy and work to create a podcast of more than an hour, available on the Institute's SoundCloud.



OUR OPENING UP TO THE WORLD

Here and everywhere around the world, our activities lead us to enter into interactions with women and men, professionals, researchers, students and partners. This desire to go further, to widen the scope of possibilities, to create new connections, is rooted in our DNA. Through these exchanges and this sharing, we grow.



International

2021 international policy

129 agreements with **100** universities
in **28** countries on **5** continents

33 double-degree agreements and
85 non-graduate exchange agreements

45 Erasmus+ agreements in **13** partner
countries and **45** Partner Universities

101 outgoing mobilities achieved in Europe
thanks to the Erasmus programme

518 international students
of **61** different nationalities on campus



100 partner
universities
in **28** countries
on **5** continents



34% international students among our 2021
graduates, engineers, masters, advanced
masters and doctoral students

40% of international students among those
recruited in 2021

International policy

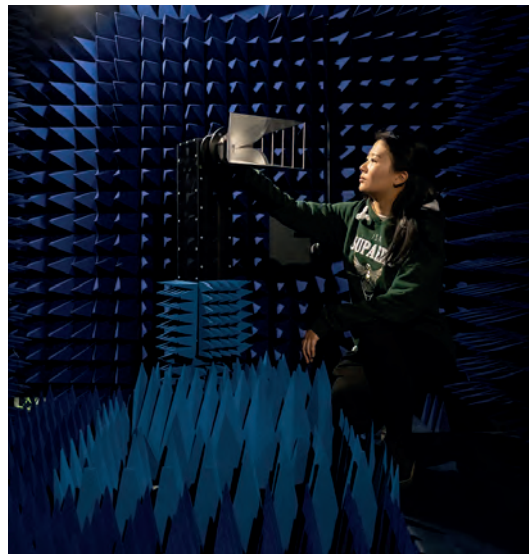
The year was marked by the implementation of development actions and the signing of new cooperation agreements that provide an institutional framework for collaboration, in particular to secure and sustain student and lecturer-researcher exchanges.

Significant work was performed, despite the global health situation, by signing new agreements with universities in Argentina, Brazil, the United States and Russia and renewing agreements with several universities already partners of ISAE-SUPAERO. Moreover, development activities have been stepped up with the countries of the Middle East region, particularly in the context of industrial cooperation.

Seen in 2021

ISAE-SUPAERO coordinates the European University project UNIVERSEH on behalf of the Federal University of Toulouse Midi-Pyrénées. 2021 was dedicated to the implementation of the first year of the project and a second European call for projects was won to develop the research aspects of UNIVERSEH: BEYOND UNIVERSEH.

ISAE-SUPAERO took part in the France-Central America academic forum by contacting several universities in this geographical area with which the Institute has had few collaborations so far.



Signing of partnerships

23 agreements were signed, including the renewal of 7 double-degree agreements with Belgian universities (Université Libre de Bruxelles, Vrije Universiteit Brussels, Université de Liège and Université de Mons), Argentina (Universidad Nacional de Cordoba) and Russia (Moscow Aviation Institute), 2 new double-degree agreements with Novosibirsk State University in Russia and Universidad Carlos III in Madrid and 4 new partnerships with Tokyo University of Science, Università Di Pisa, University of Limerick and University of Auckland.



Sponsorship and corporate relations

More than ever, one of the missions of ISAE-SUPAERO is to support companies in their major transformations by offering tomorrow's engineers courses that take into account the transitions of different sectors such as decarbonization and innovation. This is why we continue to build strong and long-lasting relationships with industry in the aerospace, defense and other industries such as transportation, energy, digital, consulting, strategy and finance. More than 250 companies support our development and more than 30 partnerships have been signed with SMEs and major economic players. Our teaching and research sponsorship chairs, developed in conjunction with the ISAE-SUPAERO Foundation, also contribute significantly to the development of the Institute.

Once again this year, we have carried out many actions serving to support the professional integration of our students and to maintain it at a very high level, despite the crisis.



Seen in 2021

CASAC Chair

Renewal of the CASAC Chair. (Design and Architecture of Cognitive Aerial Systems) with Dassault Aviation, this chair focuses on neuroergonomics, high autonomy systems and systems engineering. The first component has enabled significant progress to be made in several areas aimed at developing a better relationship between humans and operating systems, such as in cockpits or teleoperating stations. The new edition of the Chair proposes to bring together the themes "Neuroergonomics" and "Conduct and Decision" under the name: "Towards effective Human-Machine coupling".

Sponsors/Scholars meeting

Organized by the Foundation for the 5th consecutive year, this meeting brought together 30 scholarship students and 5 corporate sponsors (Airbus, GIFAS, MBDA, Thales, and the ISAE-SUPAERO Foundation).

ICCAS: Organized as part of the CASAC Chair, the first international conference on cognitive aircraft systems (ICCAS) was held in the form of a webinar on May 18. This 100 digital edition focused on promoting the diffusion and exchange of scientific information for the next generation of civilian and military aircraft. The webinar, which brought together nearly 400 participants, covered a wide range of theoretical and practical topics related to neuroergonomics, human factors, and artificial intelligence.



New structuring partnership agreements

- Driven by new opportunities, an increasing number of companies, eager to anticipate the future and boost their innovation capabilities, are looking to get closer to our engineers and research teams. New companies have thus engaged with us:
3DS, NEXTER, PARROT, VOLOCOPTER, ALSTOM, BAIN, ALTEIA.
- Extension of skills sponsorship to neuroergonomics with **LabSoft**
- Aviation neuroergonomics - Multimodal alarms contingent on a virtual flight task.



Career Center:

*A real asset
for the professional integration
of our students*

More than 1,700 students came to seek advice during individual interviews or group workshops in 2021. More than 1,900 job offers or internships were posted on the Institute's careers platform. Thanks to the partnerships signed this year, more than 30 face-to-face or distance-learning events were offered to students to help them improve their knowledge of the industrial world and develop their network.



SPONSORSHIP PARTNERSHIPS:

8 Chairs

- **DAHER - ISAAR** (Innovative Solutions for Aviation Architecture & Regulation) - Design and certification of innovative aircraft architectures CS-23
- **AIRBUS - CEDAR** - Chair for Eco-Design of Aircraft
- **MBDA** - India and Indonesia Program of Excellence
- **AXA** - Neuroergonomics for Aviation Safety
- **DASSAULT AVIATION - CASAC** - Cognitive Aerial Systems Design and Architecture
- **SAFRAN - AEGI S** - Aero Engine Innovative Studies
- **AIRBUS DEFENSE AND SPACE - ARIANE GROUP - SACLAB** - Space Advanced Concept Laboratory - Advanced Space Concepts
- **GIFAS** - Support to the ISAE Group

Skills sponsorship

- **LABSOFT** - digital learning / neuroergonomics

New in 2021



Creation of the 100% English-spoken career path

In addition to the existing offer to help students become aware of their talents and support them in their job search and internships, the CAREER PATH is a complete and progressive system integrated into the students' study cycle. They can thus benefit from theoretical and practical contributions on the fundamentals of professionalization, with broader emphasis on support and advice.

Development of the Alumnus relationship

In order to foster the development of the Institute, particular emphasis was placed this year on the development of the Alumnus relationship in complementarity/synergy with ISAE-SUPAERO ENSICA Alumni, through the study of an Alumnus engagement program.

The objective of this program is to accentuate the link between Alumni, students and the Institute, and to strengthen the feeling of belonging of students to the ISAE-SUPAERO community from the first year of study, by sharing an updated vision of the Institute with the Alumnus community and generating joint experiences around projects of the Institute (training, student integration, innovation projects, sustainable development, international, etc.).

Pilot actions were conducted such as the organization of a class anniversary, a Defense business conference and a partner morning on the theme of alumni in order to create synergies with students and share good practices.

A key partner in the aeronautics and space industry

The ISAE Group's vocation is to bring together schools in the field of aeronautics and space engineering under the same banner. It seeks to meet the needs of the aerospace sector by offering a wide range of dedicated training programs (Engineering, Masters, Advanced Masters and Doctorates) so as to constitute a quality label for these programs and develop joint projects among its members. With five schools, some thirty training programs and more than 1,500 graduates a year, the ISAE Group provides industrial and institutional players in the aeronautics and space sector with a wide range of graduates with high-level scientific and technical profiles unique in Europe.

5 Top-level schools [grandes écoles]

ISAE-SUPAERO | [Toulouse](#)

ISAE-ENSMA | [Poitiers](#)

ISAE-SUPMECA | [Saint-Ouen](#)

ESTACA | [Saint-Quentin-en-Yvelines and Laval](#)

École de l'Air et de l'Espace | [Salon-de-Provence](#)

Partner schools since 2020

ESTIA | [Bidart](#)

EIGSI | [La Rochelle and Casablanca](#)

Elisa Aerospace | [Saint-Quentin and Bordeaux](#)

Strategic thinking carried out within 5 committees

- Training
- Digital Learning
- International relations
- Promotion-image
- Ecological Transitions



The ISAE-SUPAERO

4,000
engineering students

6,000
students

1,500
graduates per year

160
partner universities (representing 140 countries on 5 continents)

A network of
42,000
alumni

Seen in 2021

Revision of the ISAE Group's Articles of Association

Three main amendments were made to optimize the organization and operation of the ISAE Group association created in 2018

- The designation of member is now reserved for schools that have adopted the ISAE brand. In 2021, three schools took advantage of this status: ISAE-SUPAERO, ISAE-ENSMA, ISAE-SUPMECA. ESTACA and the École de l'Air et de l'Espace become associated schools; EIGSI, ESTIA and ELISA Aerospace retain their designation of partner schools
- The abolition of unanimity voting to avoid deadlock situations.
- Opening the board of directors to personalities outside the academic world

The Euroglider project takes an important step

The EUROGLIDER project aims to develop a two-seat glider for teaching, release and electric propulsion training. It is the result of an innovative partnership launched at the end of 2014 and bringing together the European Association for the Development of Gliding (Association Européenne pour le Développement du Vol à Voile - AEDEVV), Dassault-Aviation and the engineering schools of the ISAE Group. Euroglider addresses three challenges: operational, environmental and economic. An important step was taken on May 27, 2021 at the École de l'Air et de l'Espace, with the fully autonomous taxiing and take-off of the flight test bed.

The Euroglider project is currently entering its industrial phase.

Other highlights

- Successful completion of ISAE Group apprenticeship training. Initiated in September 2020 at ISAE-SUPAERO, the deployment of this course continued in 2021 at ISAE-ENSMA before expanding to ISAE-SUPMECA in 2022. the vast majority of apprentices quickly signed their contract with companies in the aerospace sector, highlighting the attractiveness of this training to economic stakeholders.
- Creation of a fifth thematic committee focused on "Ecological Transitions" to make the Group a key player for a sustainable aviation sector.

Group development supported by GIFAS

For the past six years, the Groupement des Industries Françaises Aéronautiques et Spatiales (GIFAS), which brings together more than 400 SMEs and major industrial groups in the sector, has provided substantial financial support for the development, outreach and social opening of the ISAE Group and its schools.



ISAE SUPAERO ENSICA Alumni, a network structured around its classes, its geographical groups, in France and abroad, its thematic groups and its company correspondents.

24,500 More than graduates

More than **18,000** in activity, including:

440 in North America,

1,270 in Europe and

290 in Asia.

ISAE SUPAERO ENSICA Alumni

A committed association at the service of the ISAE-SUPAERO community

Founded in 1911, the association called "Amicale des anciens élèves de l'Institut Supérieur de l'Aéronautique et de l'Espace" bears the brand name ISAE SUPAERO ENSICA Alumni. Recognized for its public utility since 1922, it brings together graduates of ISAE-SUPAERO and its founding schools.

Its 3 primary missions are:

- to operate the Alumni network, both on a friendly and professional level;
- to carry out intergenerational solidarity actions;
- to contribute to the outreach of the network and ISAE-SUPAERO.

ISAE SUPAERO ENSICA Alumni is a partner of ISAE-SUPAERO and the ISAE-SUPAERO Foundation, of which it is a founding member.

Seen in 2021

A network based on friendship and solidarity

Participation in welcoming new students, class inauguration and graduation, class sponsorship, organization of class anniversaries and friendly events.

Help for students and classmates in financial difficulties.

A dynamic career employment service

Professional coaching and mentoring, career advice during monthly workshops, organization of conferences and webinars on the subject of recruitment, publication of more than 3,500 job offers (including nearly 80 previews, coming directly from Alumni), active presence on Facebook and LinkedIn social networks, publication of the detailed annual report of IESF on the employment of engineers.

A connected network

A collaborative website, a directory of graduates in digital and paper formats, a quarterly newsletter, ISAEdre, a regular newsletter, Les NousVAiles.

An outreach network

Organization of the **60th anniversary in Toulouse**, with in particular a remembrance morning in Jolimont and an exhibition marking the 60th anniversary of the arrival in Toulouse of the first class of students-engineers in aeronautics.

Organization of thematic **conferences**, such as "The Future of Civil Aviation, what uses for our societies? ", on the occasion of the Institute's Open Day.

Association and SAE (Société des Amis de l'ENSTA et de l'ISAE-SUPAERO) Awards presented to deserving graduates (engineers and Mastère Spécialisé®).

Presentation of the **Mayoux-Dauriac Award**, generously endowed thanks to the legacy of our comrade Maurice Mayoux (deceased in 1997), to reward practical achievements of students in the last year of their engineering program.

Support for ISAE-SUPAERO in the promotion of its courses.



A campaign dedicated to student aid on campus and ever more supportive donors

With a collection of more than €376k from individuals and nearly €1.95m from companies, the Foundation experienced in 2021 a strong growth in the commitment of its donors towards beneficiaries, as well as the maintenance of that of sponsors who support the chairs and programs of ISAE-SUPAERO.

57 scholarships granted

- 5 for international mobility
- 14 in support of research exchanges
- 8 for extracurricular projects
- 8 for the participation in or organization of international conferences
- 4 Entrepreneurship start-ups
- 11 scholarships for excellence in hosting foreign students, awarded thanks to the support of sponsoring companies (AIRBUS, MBDA, GIFAS) as well as the ISAE-SUPAERO Foundation.
- 5 thesis prizes
- 2 entrepreneurship prizes

The ISAE-SUPAERO

Seen in 2021

Closing of a Class Gift committed to training on sustainable development issues within ISAE-SUPAERO

The classes of 1981 and 2011, joined by the class of 2001, have come together around a common project that carries meaning for the training of engineers: going beyond the framework and helping them to become citizen engineers through training dedicated to environmental issues. Joined during the year by the class of 2001, for which the first Class Gift project could not be completed, the three classes were able to raise €28,155.

A donation campaign for students in difficulty on campus following the ongoing health crisis

In its first donation campaign of the year, the Foundation, in response to the emergency situations of some students, launched a campaign to help them. Building on its success, the campaign brought together more than 211 generous donors and raised €75,500 to support students in difficulty.

Jean Lucien Lamy's commitment

Jean L. Lamy, S 1971 has been a donor since 2009. In 2021, convinced of the importance of generosity with his former school, he expressed to the ISAE-SUPAERO Foundation his desire to provide significant long-term support, in order to finance each year several scholarships in the two specific areas of mobility and entrepreneurship. By this act, he is the first donor to enter the rank of honorary member of the Foundation's Jules Verne Circle.

Renewal of the Chair with Dassault Aviation

On the business side, 2021 allowed the continuation of existing chairs, along with the renewal of the CASAC Chair, which had expired. Thus, this Chair signed with Dassault Aviation will continue to bring together different research departments of ISAE-SUPAERO around neuroergonomics, high autonomy systems and systems engineering.

Actions of the ISAE-SUPAERO Foundation

The Foundation contributes to the global reach of ISAE-SUPAERO by accelerating the implementation of innovative projects that contribute to a sustainable world through donations collected from individual sponsors (alumni, parents, students and enthusiasts in the aerospace sector) and corporate sponsors. Corporate sponsorship allows the creation of teaching and/or research chairs with the Institute,

along with programs of excellence. The generosity of individuals mainly contributes to the projects of students, doctoral students and lecturer-researchers around 5 support areas:

- Research and teaching
- Entrepreneurship
- The Institute's international outreach
- Innovative teaching
- Diversity and social awareness through the DARE ISAE-SUPAERO social awareness program



A commitment to equal opportunities for all in access to higher education

13 partner middle schools and **12** high schools of the Academy of Toulouse.
4,000 young people made aware, including **700** through local support
by more than **200** students, lecturer-researchers, staff and alumni.

School support, tutoring especially for students with disabilities, discovery of higher education, discovery of the industrial and aeronautical sectors, scientific and technical workshops punctuate the school year.

Discovering science differently: Mars in class

*Why should we explore the surface of Mars? Why and how can we bring back samples?
How do we select and analyze them? All these questions, and many more, are addressed
in the "SuperCam – Martian exploration" educational package project.*

Under the leadership and guidance of astrophysicist and alumnus Sylvestre Maurice, 12 first-year students from ISAE-SUPAERO produced an educational tool to raise awareness of space exploration in the classroom, from sixth grade to final year.

Throughout 2021, engineering students, teachers of partner middle and high schools, engineers and researchers from CNES, ISAE-SUPAERO, CNRS and experts from the Cité de l'Espace co-constructed a digital package dedicated to Martian exploration and

more specifically to the SuperCam instrument on NASA's Perseverance rover.

Managed at the academic level, this project resulted in the national deployment of an educational toolkit combining exercises, experiments, tutorials, quizzes, photos, videos and interactive presentations on the major themes of exploration. This package is available to middle and high school teachers and offers various pedagogical sequences.

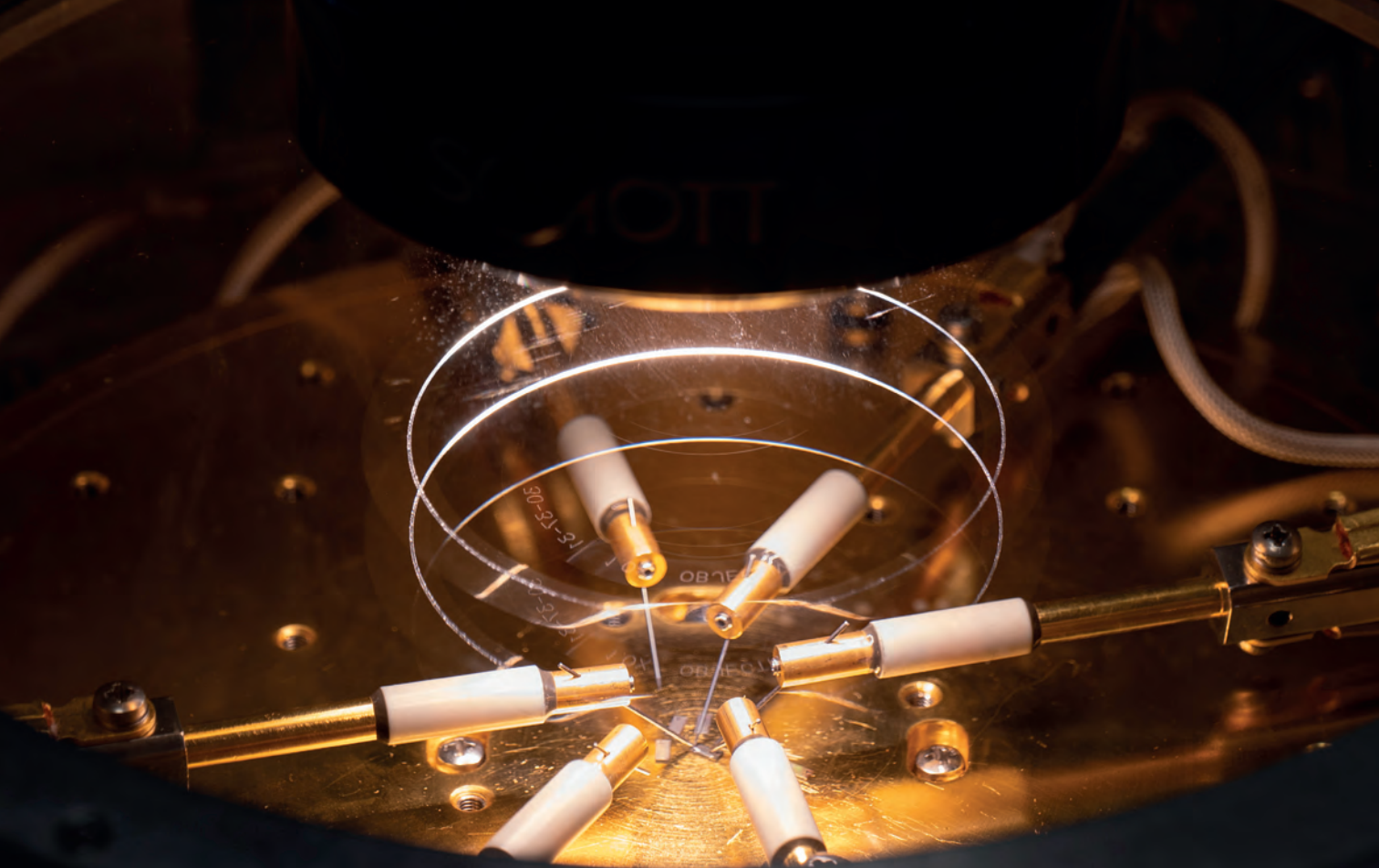


Presentation of the
SUPERCAM
educational package



The "SuperCam – Martian exploration" project in a few figures:

- 20** educational sheets for middle schools, by level and by subject
- 20** educational sheets for high schools
 - 1** photo exhibition
 - 6** videos, including scientific experiments to perform in the classroom
 - 1** e-learning course entitled "Mars in January" intended for teachers from all over the country and led by the technical and scientific teams of the SuperCam instrument: 250 live participants
- 480** young people and parents connected on February 18 to witness the landing of the Perseverance rover led by students from the Mars Club
- 12** pedagogical session test classes



Committed to a dynamic of invention

It is with passion and commitment that we give everyone the keys to train, research, initiate, innovate and undertake.

Teaching innovation

As part of its new COP 2022-26 objective and performance contract, the Institute is resolutely committed to distance learning and new digital teaching in order to significantly extend the footprint of its training activity to new audiences.

ISAE-SUPAERO is working on the development and implementation of a 100% online diploma course for an international audience in the sector of air transport transitions.

This program impacts all campus courses as part of the development of digital content.

In the longer term, the Institute intends to position itself in the design of new digital training models. The aim is to design, test and implement new models of digital educational activities such as certification and validation of skills or personalized and adaptive training.

Finally, ISAE-SUPAERO wishes to echo the "Industry 4.0" movement, in order to transform it into an environment even more conducive to educational innovation with digital technology. By developing an education 4.0, the aim will be to set up a teaching cloud, to develop "data-driven" training with traces of learning and artificial intelligence, to create a Learning Lab to encourage and facilitate pedagogical innovation.

6 online courses signed by ISAE-SUPAERO accessible to the 75 million users of the Coursera platform

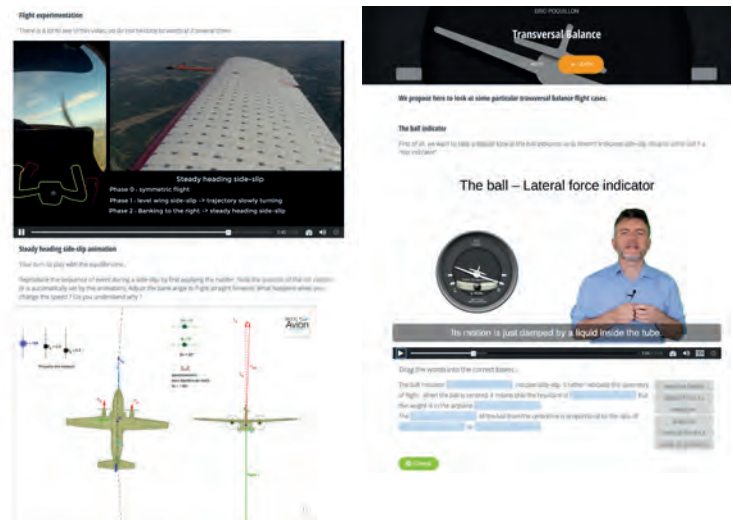
Digital transformation with IDEA (Innovations Digitales pour l'enseignement Aéronautique - Digital Innovations for Aerospace Education)

For the past several years, the Institute has been developing digital technology and has been an environment conducive to "digital learning". Consisting of multidisciplinary skills, educational engineers, full-stack developers and aeronautical experts, the IDEA team is focused on teaching with digital technology, even though its strategic action impacts a broader digital spectrum. It leads an innovation-oriented approach in the context of R&D activities on technologies for education. IDEA participates in the development of training programs using digital technology and on providing support to teachers in conducting digital educational activities.

100% online courses with high international visibility

6 online courses signed by ISAE-SUPAERO are accessible to the 75 million users of the Coursera digital training platform. In addition to the "MOOC Avion" in French, four of them are integrated into a "Fundamentals of Flight Mechanics Specialization". The aim is to offer a practical understanding of flight mechanics. This production of online courses will be continued in 2022 with at least one course around NewSpace on launchers

Visit the Coursera campus



Innovation

EdTech platforms
for ISAE-SUPAERO
and beyond!



ADN: Aerospace Digital Nuggets

These are our reusable educational micro-contents, accessible online and lasting less than 30 minutes in learning time. They allow the fragmentation of some educational content, while making it possible to address a complex notion.

NaaS: Nuggets as a Service

This technical-functional ecosystem allows the implementation and dissemination of ADNs according to a service-oriented approach. It is developed in-house with the support of several private and public partners.

IREAL: Interactive Remote Expérimentation for Active Learning

This new learning modality completes the range of existing possibilities at the Institute and its partners, including UFTMIP/Toulouse Tech. The platform focuses on learning by doing and scientific experimentation. It allows large numbers of students to simultaneously use the experimental devices to access a digitized version of the equipment as part of their course, at any time, from any place and from any type of digital equipment.

Check out the
IREAL experiments
already online

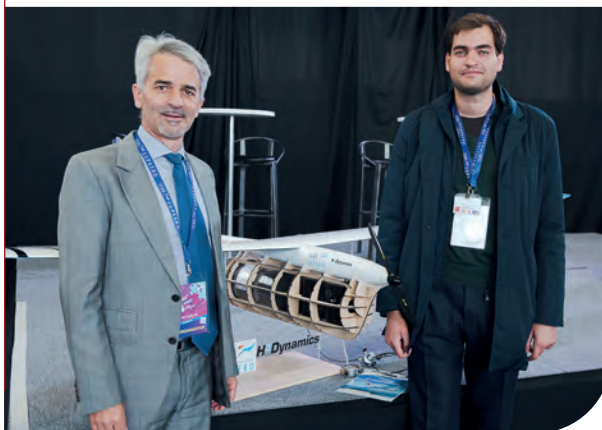


Exploratory innovation

The MERMOZ hydrogen drone
project passes several
significant milestones

During 2021, a wind tunnel model of the drone was made and tested in the SabRe wind tunnel, ISAE-SUPAERO Drones wind tunnel. This campaign served to select the optimal propeller for cruising flight, to reduce the coefficient of aerodynamic drag at cruise by improving the shape of the wing-fuselage junction (Karmans) and to study the influence of air inlets and outlets on the drag balance.

Two hydrogen propulsion chain validation campaigns were prepared with our partner H3Dynamics, in collaboration with the LAPLACE laboratory and the company H2-PULSE in order to carry out the first flight tests during the first semester of 2022. In parallel, two instrumented liquid hydrogen tanks that will equip the second version of the drone were manufactured and tested by hylium, a Korean partner in the project.



Prof. Jean-Marc Moschetta (left) and Dr. Nikola Gavrilovic (right)
in front of the ISAE-SUPAERO/H3Dynamics prototype of the Mermoz hydrogen drone



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Image, ESA, CNES, École de l'Air et de l'Espace
Design: ISAE-SUPAERO
Printing: Equinox
February 2022



Recycled paper



Vegetable-based ink

