

ANNUAL REPORT

2015

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ONERA

THE FRENCH AEROSPACE LAB

ONERA

THE FRENCH AEROSPACE LAB

Editorial

Bruno Sainjon, Chairman and CEO of ONERA



The year 2015 was marked by many successes, both scientific and economic. They are the fruit of collective work and demonstrate, if proof were needed, the quality of ONERA's men and women, as well as their commitment to the success of our institution.

Economically, we ended the year with annual accounts showing a surplus of 5.2 million euros, although we had expected a small deficit. This year 2015 therefore ends with positive economic dynamics. This result can be explained by strict management, coupled with substantial savings in all areas (human resources, operation, investment).

However, we still need to remain careful in some aspects. Of course, the S1MA Modane wind tunnel consolidation work will be able to begin, but it will take several years for ONERA to recover an investment capacity suitable for the challenges that it faces. Similarly, our Île-de-France facilities require all of my attention, because they are an important factor for our future performance.

ONERA's Scientific Strategic Plan, established in close relationship with our institutional and industrial partners, is now available. It clearly outlines the challenges that we must overcome in our areas of excellence, to always remain a key part of the European aerospace sector economic and industrial dynamics.

The preparation of the objectives and performance contract that we will sign with the State in 2016 was also an important issue this year. It will allow us, in perfect symbiosis with our supervision, to continue the recovery which began in particular with the DGA, DGAC and CNES.

The fact that ONERA was chosen to lead the Carnot aerospace sector bears testimony to the recognition of our excellence.

Our achievements transcend borders. Our proficiency has been widely recognized in Europe both with H2020, in which the four international cooperation projects with Canada, Japan and China submitted by ONERA were selected, and with CleanSky 2. My election to the presidency of the EREA, the Association of European Research Establishments in Aeronautics, is also a sign of this. More widely, our relationship with NASA, the Russian TSAGI, the Singapore DSO and the DLR, to name but a few, places us indisputably among the organizations that count within the realm of aeronautics and space research.

With these successes, a reaffirmed close relationship with its partners and the confidence that all have shown in it, ONERA will celebrate its 70 years in 2016 and will continue to prepare the future of the French and European aeronautics and space industry with determination and enthusiasm.





ONERA

THE FRENCH AEROSPACE LAB

ONERA: the French aerospace research center

ONERA, a central player in aeronautics and space research, employs approximately 2,000 people. Under the supervision of the Ministry of Defense, it has a budget of 230 million euros, of which more than half comes from commercial contracts. As a government expert, ONERA prepares tomorrow's defense, meets future aerospace challenges and contributes to the competitiveness of the aerospace industry. It masters all of the disciplines and technologies in the field. All major civil and military aerospace programs in France and Europe have some of ONERA's DNA: Ariane, Airbus, Falcon, Rafale, missiles, helicopters, engines, radars, etc. ONERA carries the Carnot research/company partnership label. Its researchers, who are internationally recognized and have often received awards, train many doctoral students.



Getting back into the aerospace research game

The Scientific Strategic Plan (SSP) is a key part of ONERA's overall strategy, which specifies the major scientific challenges and the main research areas for the next five to ten years. Having been largely consolidated in 2015, the SSP, which was completed in early 2016, favored a path of openness and dialogue.

Internally first, since the SSP has been widely open to discussions to gather the views and comments of all, in order to make choices and take directions that best meet the expectations of the industrial and state parties in ONERA.

The SSP has also been shared and discussed with ONERA's Scientific High Council as well as with its main partners in the aerospace and defense sector, such as the DGA, DGAC, CNES and GIFAS. Objective: to achieve a shared scientific and technical vision, validate the relevance of the proposed lines of research and discuss together how to implement them effectively.

For Stéphane Andrieux, general scientific director of ONERA, it is a case of "getting back into the center of the research game in a changing environment". It is thus essential for ONERA, through the SSP, to develop an ongoing relationship with the official departments and to be capable of supporting companies on the basis of joint projects and this as from the lower TRL.

Key figures

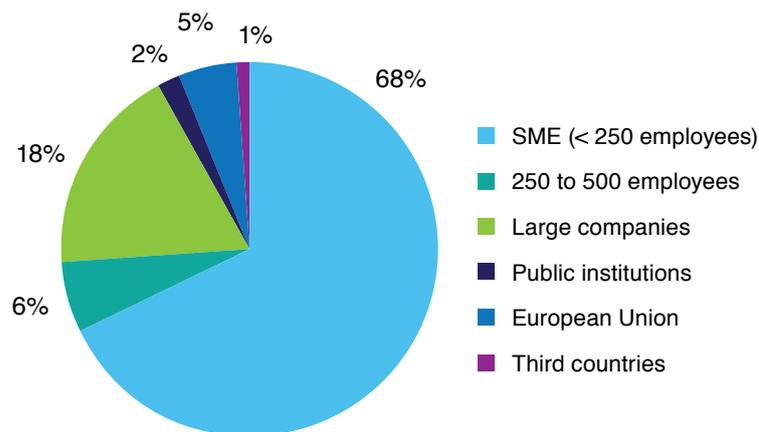
2015 investments: 17.3 million euros (19.3 million euros in 2014)

ONERA has a complete and varied range of experimental facilities, suitable for each stage of the research process. These facilities require constant renovation and maintenance effort, for ONERA to maintain its level of excellence.

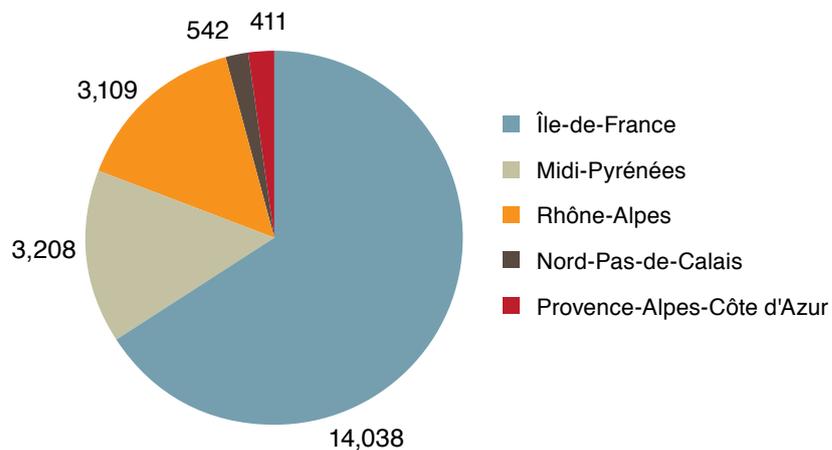
Purchases

ONERA works predominantly with SMEs at all its centers, in all regions as a whole.

Purchases by type of company in 2015



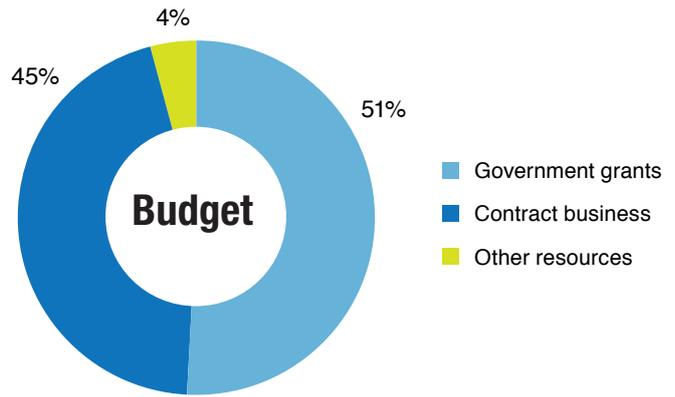
Regional distribution of SME partners in millions of euros



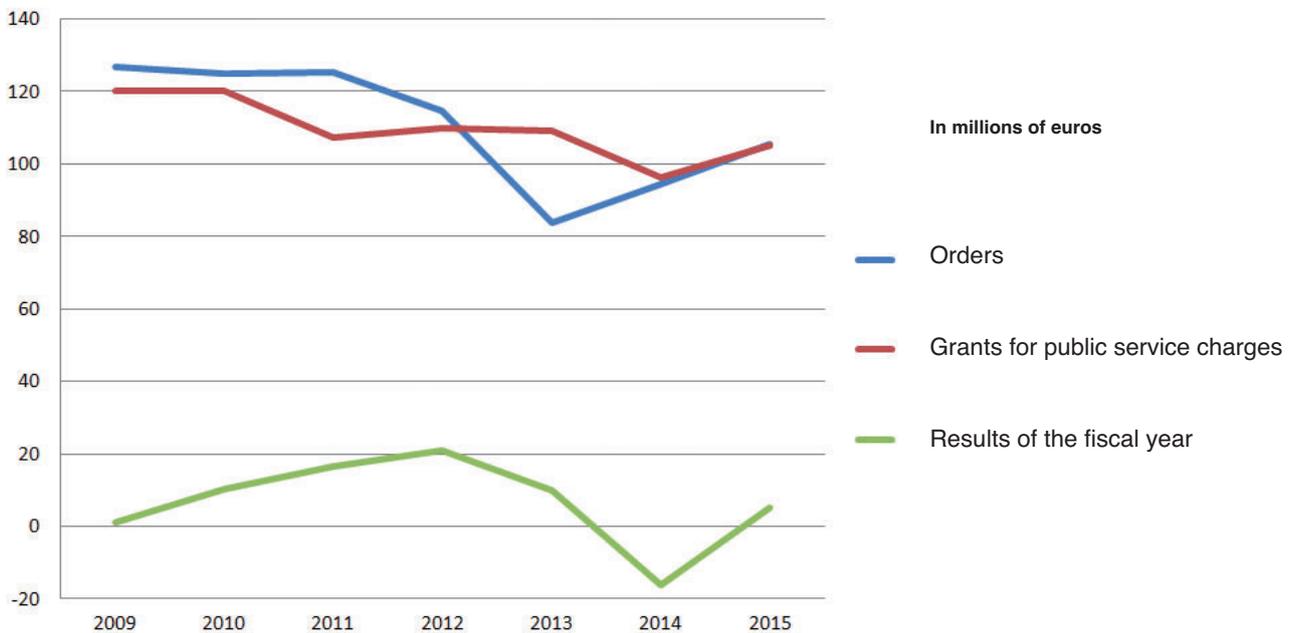
A budget of 225 million euros

114 million euros in government grants, including 105 million euros in GPSC (Grants for Public Service Charges)

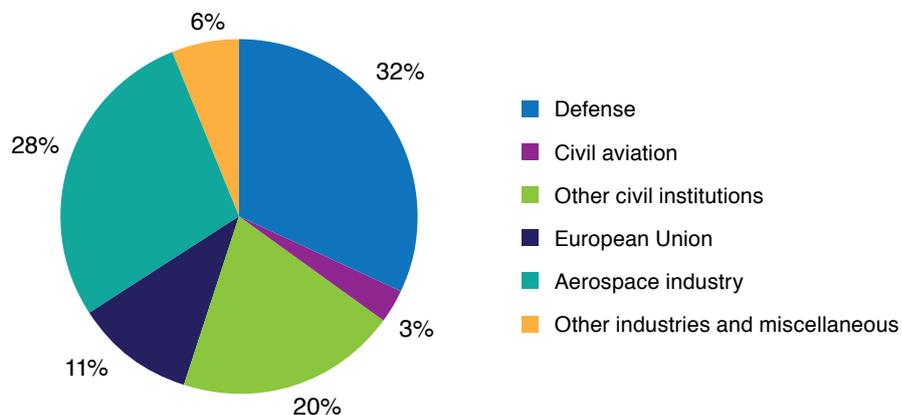
106 million euros in contracts won



2015: a financial year that brings back balance



Contract business by field in 2015





ONERA'S EXECUTIVE COMMITTEE

From left to right: **Thierry Michal**, general technical director, **Stéphane Andrieux**, general scientific director, **Antoine Torres**, communication director, **Jean Leger**, general secretary, **Bruno Sainjon**, chairman and CEO, **Charlotte Haurie**, director of human resources, **Patrick Wagner**, major technical facility director, **Thierry Stoltz**, director of economic and financial affairs, **Michel Humbert**, director of business development and commercialization



ONERA'S SCIENTIFIC HIGH COUNCIL

From left to right: **Alain Appriou**, deputy general scientific director of ONERA and secretary of the SHC, **Francisco Chinesta**, professor at the ECN, member of the IUF, **Christian Picollet**, deputy central director of the SAFRAN Research and Technology group, **Michel Lebouche**, professor emeritus at the University of Lorraine, **Philippe Baptiste**, scientific director of Total, **Hisham Abou-Kandil**, scientific advisor of the DGA and head of the research and scientific innovation mission, **Michel Deville**, honorary professor of the EPFL, **Catherine Cesarsky**, top scientific advisor to the managing director of the CEA, member of the academy of sciences, chairman of ONERA's SHC, **Antoine Petit**, chairman and CEO of INRIA and **Bruno Sainjon**, chairman and CEO of ONERA.

Absent from the photo: **Richard Bonneville**, research and innovation general directorate, MENESR, **Serge Bissini**, director of research and innovation, general commission for sustainable development, MEDDE.

ONERA's scientific and technical organization

SCIENTIFIC BRANCH	SCIENTIFIC AND TECHNICAL DEPARTMENTS	Long-term Aerospace Planning
Fluid Mechanics and Energetics	<ul style="list-style-type: none"> > Aeroacoustics > Applied Aerodynamics > Fundamental and Experimental Aerodynamics > Fundamental and Applied Energetics > Computational Fluid Mechanics > Aerodynamics and Energetics Modeling 	
Physics	<ul style="list-style-type: none"> > Electromagnetism and Radar > Space Environment > Physics and Instrumentation > Theoretical and Applied Optics 	
Materials and Structures	<ul style="list-style-type: none"> > Aeroelasticity and Structural Dynamics > Composite Systems and Materials > Metallic Structures and Materials > Laboratory for Microstructural Investigations* 	
Information Processing and Systems	<ul style="list-style-type: none"> > Systems Control and Flight Dynamics > System Design and Performance Evaluation > Information Processing and Modeling 	
Computing, Engineering and Testing Facilities (GMT)	<ul style="list-style-type: none"> > Modane-Avrieux wind tunnels > Fauga-Mauzac wind tunnels > Design, Engineering and Manufacturing > Software Products and Services 	

* ONERA-CNRS joint unit

Human resources

1,987
COLLABORATORS

1,471 ENGINEERS & MANAGEMENT STAFF

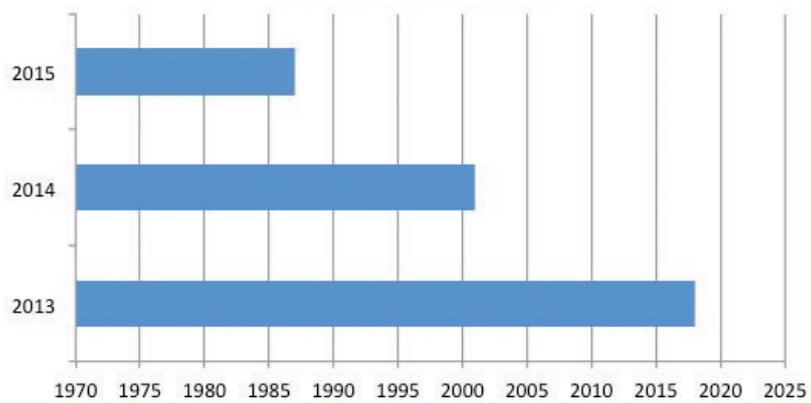
24% WOMEN

247 DOCTORAL CANDIDATES

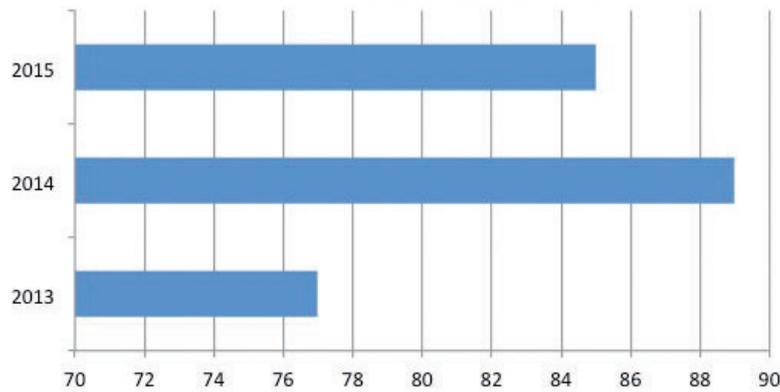
241 INTERNS

85 NEW HIRES INCLUDING
48 ENGINEERS AND MANAGEMENT STAFF

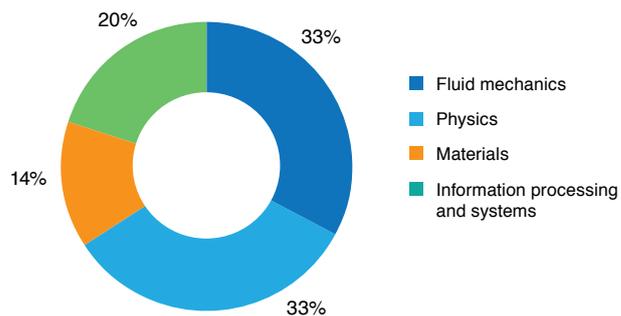
CHANGES IN STAFF
(NATURAL PERSONS)



CHANGES IN NEW HIRES



SCIENTIFIC ORGANIZATION BY FIELD



RPS AGREEMENT



Preparation together with the social partners of an agreement on psychosocial risks signed in January 2016

SALARY CONTINUATION



Establishment of Salary Continuation (continued income when unable to work due to illness)

DISABILITY



1st awareness campaign: "To not be ashamed of revealing a disability"
2 "Handi-café" hiring forums

RETIREMENT



Retirement planning meetings: 96 people listened to

300

TEACHING RESEARCHERS

9

HIRING FORUMS

33

INTERNAL TRANSFERS

Training future researchers



Training through research is one of the six missions included in ONERA's statutes. In return, for its research engineers, it is rewarding to train doctoral candidates, post-doctoral candidates and interns, because they offer a way to refresh ideas and methods.

In 2015, ONERA had **247 doctoral candidates** and **72 theses** were supported. Supervised by no less than **86 doctors with HdR** (accreditation to supervise research), that is to say, engineers with sufficient professional and scientific background for mastering a research strategy in a scientific field, to mentor young researchers.

Articles published in peer-reviewed journals: 256

Papers submitted for peer-reviewed conferences: 340

Technical reports: 1,186

Post-doctoral candidates present: 19

TESTIMONIAL: SERGE KRUCH, RESEARCH DIRECTOR OF THE DEPARTMENT OF METALLIC MATERIALS AND STRUCTURES



“ Obtaining an HDR is a personal recognition. For ONERA, it is also a way to increase its visibility in the academic world, to attract the best candidates to the thesis subjects that we offer. To ensure the success of a thesis is also the role of a research director, who makes sure that our researchers can co-mentor, teach, participate in learned societies and publish their work under the best conditions.

Not to mention that it is also personally rewarding to work with doctoral candidates, who not only bring a freshness of spirit, but also often different and original perspectives.

For doctoral candidates, doing their thesis work at ONERA is a guarantee of quality and an opening towards an academic career or towards industry, according to their preferences. ”

SCIENTIFIC AWARDS

Nicolas Jeannin received the “General Ferrié Grand Prize in Electronics” for his work on “propagation within the troposphere for very high speed space telecommunication systems in the Ka and q/V bands” from the Society for Electricity, Electronics and Information and Communication Technology (SEE).

Luc Vignaud received the “Scientific Achievement Award” recognizing his work and his scientific contributions during the “Lecture Series on Radar Automatic Target Recognition and Non-Cooperative Target Recognition” of NATO’s science and technology organization.

Mikael Planes received the “Jeunes Chercheurs” award from the CNES for the “development of new stable silicone resins in geostationary environments”.

Jean-Charles Khou received the “Young Scientist” award for his work on the “Spatial Simulation of Contrail Formation in the Near-Field of a Commercial Aircraft” from the Awarding Committee of the Transport, Aviation and Climate Conference.

THESIS AWARDS

Jean-Charles Antonioli received the Padfield award for his thesis “Towards the development of a methodology for designing helicopter flight control laws by integrating handling quality requirements” from the ERF (European Rotorcraft Forum).

Ysolde Prevareaud received the Aerospace Valley award for her thesis “Development of models for the atmospheric re-entry of space debris”.

Baptiste Paul received the Université d’Aix Marseille award for his thesis “Post-coronagraphic wavefront sensing for high contrast imaging systems. Application to ground and space based instruments”.

Francesco Vitillo received the ISAE/SUPAERO award for his thesis “Experimental and Numerical Contribution to Heat Transfer Enhancement in Compact Plate Heat Exchangers”.

Ghislain Blanchard received the ISAE/SUPAERO award for his thesis “Multiscale modeling and simulation of sheared liquid sheet atomization”.

Frédéric Cristini received the Clément Ader award for his thesis “Improving the resilience of space systems to threats: autonomous satellite networks”.

D I S T I N C T I O N S

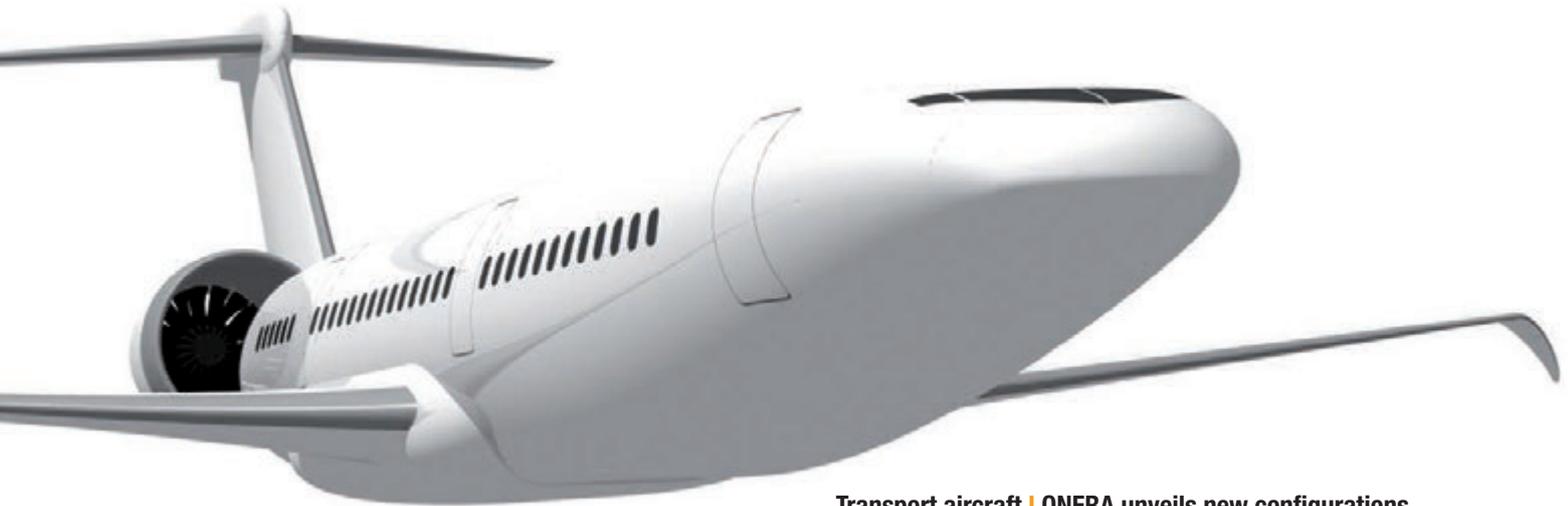
Véronique Padoan, named Knight of the Legion of Honor by the decree of 03/04/2015

Corinne Le Hong, named Knight of the National Order of Merit by the decree of 15/05/2015

Patrick Wagner, Knight of the Legion of Honor by the decree of 13/07/2015

Marie-Pierre Bacos, named Knight of the National Order of Merit by the decree of 20/11/2015

2015 Highlights



Transport aircraft | ONERA unveils new configurations

Foreshadowing the evolution of a medium-haul aircraft in 2025, the four configurations of the Carnot NOVA Project (NextGen ONERA Versatile Aircraft) incorporate many innovations, such as a wide fuselage, downward winglets or engines ingesting the fuselage boundary layer. ONERA aims to remove technical obstacles for the installation of engines with very high dilution rates, which are economical but bulky.



Radar metrology | nEUROn in-flight radar cross section measurement

The nEUROn in-flight radar signature measurement test campaign at the DGA Flight Test site was very successful thanks to the ONERA measurement stations. The first results presented at the DGA were considered to be remarkable. This technologically very ambitious operation crowns a major ONERA activity for four years.

Wind measurement | A world record for range for ONERA's lidar

ONERA's wind lidar observed storm Hermann from the Palaiseau site. Maximum instrument range: 16 km depending on the weather, which is a world record for a fiber laser source based on a new generation fiber.

Radar | Measurement of electromagnetic interference from wind turbines

In order to qualify its software DEMPERE to help the Air Force to make decisions on the implementation of new wind farms, ONERA has measured the interference of a radar wave after passing through a wind farm. Special feature: a miniaturized sensor developed for a miniature drone provided the reception. The results showed significant spatial and temporal fluctuations, correlated with the rotation of the blades.



Cooperative robotics | A team of twelve drones and robots on an autonomous mission

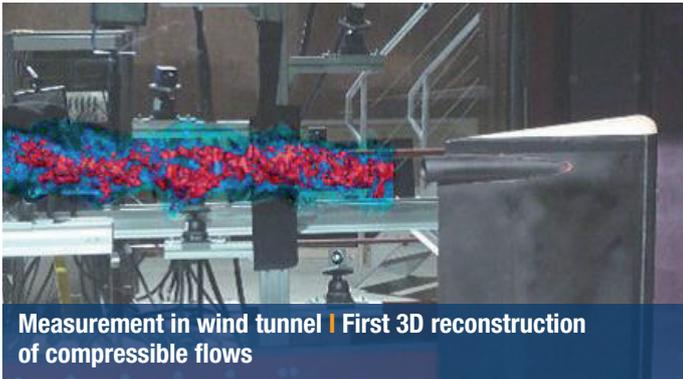
The latest demonstration of the ACTION PEA, funded by the DGA, involved twelve air and land drones in an urban environment. Objective: to validate a "decisional" distributed software architecture for the cooperation of drones participating in a common mission. The demonstration conducted by ONERA and CNRS personnel, in the presence of the DGA, was conclusive.

Acoustics | Ariane 6 launch campaign

ONERA carried out a test campaign for the ESA at the University of Poitiers - ENSMA. Its purpose was to characterize and reduce the acoustic environment to meet the payload ambience specifications and limit mechanical stresses on the launcher when its engines are ignited. Analysis of the results confirms the robustness of the preliminary definition of the Ariane 6 launch system.

Composite materials | Extreme condition test means

Through the use of CO₂ lasers to quickly heat a material, ONERA has developed a test bench for determining the life time of composites subjected to mechanical loads and heat flows that are representative of hypersonic flight. A campaign for MBDA assessed the behavior of the composites developed by ONERA.



Measurement in wind tunnel | First 3D reconstruction of compressible flows

ONERA made the first experimental demonstration of a method for the 3D reconstruction of the air volume observed. This BOS3D technique (3D Background Oriented Schlieren) was implemented in a Fauga-Mauzac wind tunnel on a hot jet and validated by temperature measurements. The BOS3D paves the way for the quantitative study of unsteady compressible flows.

Atmospheric radiation environment | Collaboration with Brazil

Collaboration between ONERA and IEAV (its Brazilian counterpart) enabled the installation of an operational neutron spectrometry system in Brazil. Similar to that operated in Pic du Midi, this station will enable better knowledge of the South Atlantic anomaly (a local singularity of the Earth's magnetic field), which can be detrimental to embedded electronics and air crews.

Pollution control | ONERA is a major player in maritime airborne remote sensing

With its airborne platform Sethi, ONERA carried out two campaigns to assess the ability of its optronic and radar means to detect and analyze pollutants in the sea. The first, Polluproof was conducted with the French Navy and French Customs, and was funded by the ANR. The second was conducted for Total.

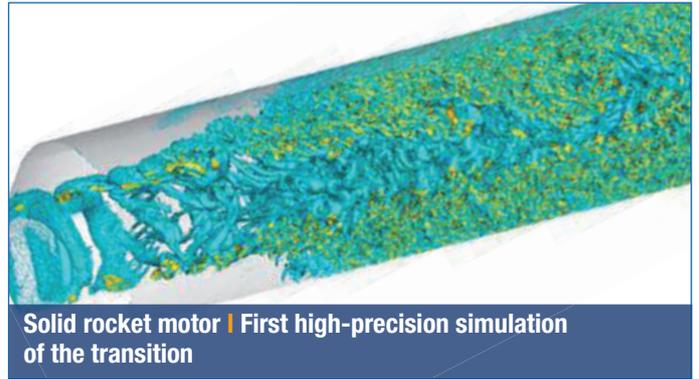


Ariane 6 | ONERA measures the unsteady pressures of the first launch of pod-Y

The first launch of the POD-y demonstrator, with the measurement and use of unsteady pressures, took place at the DGA missile testing site. Objective: to study pressure oscillations in the P120C solid rocket motor of the future Ariane 6 by gathering a large amount of high precision data.

Biometrics | Contributions of adaptive optics for iris recognition

Iris biometrics could eventually replace digital and facial recognition. The main technological obstacle: acquiring quality images with a compact and inexpensive device. A demonstrator based on adaptive optics, in which ONERA is a world specialist, has been built and the images obtained were evaluated. Funded by the ANR and led by ONERA, this study brought together Parrot, Telecom Sud Paris and Safran Morpho.



Solid rocket motor | First high-precision simulation of the transition

With the GENCI supercomputer, ONERA performed the calculation of a billion meshes with its CEDRE software. The feat: processing large volumes and getting close to the direct numerical simulation (DNS), with mesh refinements that are unprecedented in solid propulsion. Challenge: gaining a better understanding of unsteady flows in the combustion chambers of solid rocket motors, especially the transition to turbulence.

Wind tunnels | New method

For the first time, an industrial trial used pressure sensitive paint (PSP) to assess high frequency aerodynamic effects on an airfoil (up to 5 kHz). This test was conducted in one of the large industrial wind tunnels of the Modane center. This innovative paint was developed jointly by ONERA and the CSEM, a Swiss technology research center.

SWind tunnels | Shaft motorization on a complete model

For the first time under industrial conditions, a new device to increase test productivity by reducing the configuration changing time has been successfully tested in ONERA's large wind tunnels. A horizontal shaft motorization has been developed on a complete aircraft model. It allows adjustments to be performed without any intervention in the test section.



Microscope mission | Successful integration of the ONERA accelerometer on a satellite

ONERA has delivered and integrated its differential accelerometer, T-SAGE (Twin Space Accelerometer for Space Gravity Experiments), to the CNES to equip the micro-satellite MICROSCOPE. Designed and built by ONERA, the instrument will test Einstein's theory of general relativity by verifying the equivalence principle with a precision one hundred times greater than that of the best experiments performed on Earth.

Space propulsion | 3D reconstruction of an electric propulsion ion beam

Funded by ESA, ONERA has developed a unique laser diagnostic tool for measuring all velocity components of an ion beam. Their spatial distribution will be well known with an unprecedented level of detail. ONERA will offer advanced analyses to optimize the performance of new electric propulsion systems for satellites.

Busy ²⁰¹⁵ Times

FRANCE

Bourget 2015: "ONERA thinks up and tests tomorrow's breakthroughs"



From the 15th to the 21st of June, the ONERA booth featured several technological innovations and showed its ability to design complex systems for future civilian and military aircraft. With a strong message: "Without technology there are no programs, but without research there is no technology".



The Carnot institutes: 10 years of activities and results for business innovation

On the occasion of its 10th anniversary, the network of Carnot institutes presented examples of its partnership research activities between public research and industry. ONERA chose to show the projects of SONDRRA, the France-Singapore research laboratory on radar observations, and the NOVA study regarding an innovative more fuel-efficient aircraft configuration.



ONERA and the DGA together at the drone show

During the 1st edition of the UGS (Unmanned Global System) show on multi-media autonomous systems held in October in Bordeaux, the DGA stand featured the ACTION project entrusted to ONERA, which is aimed at exploring the cooperation between drones and robots. ONERA was able to share its expertise through a series of experiments on the exploration of an urban area in which rolling and flying drones share tasks and work as a team.



The DGA Innovation Forum: ONERA stands out

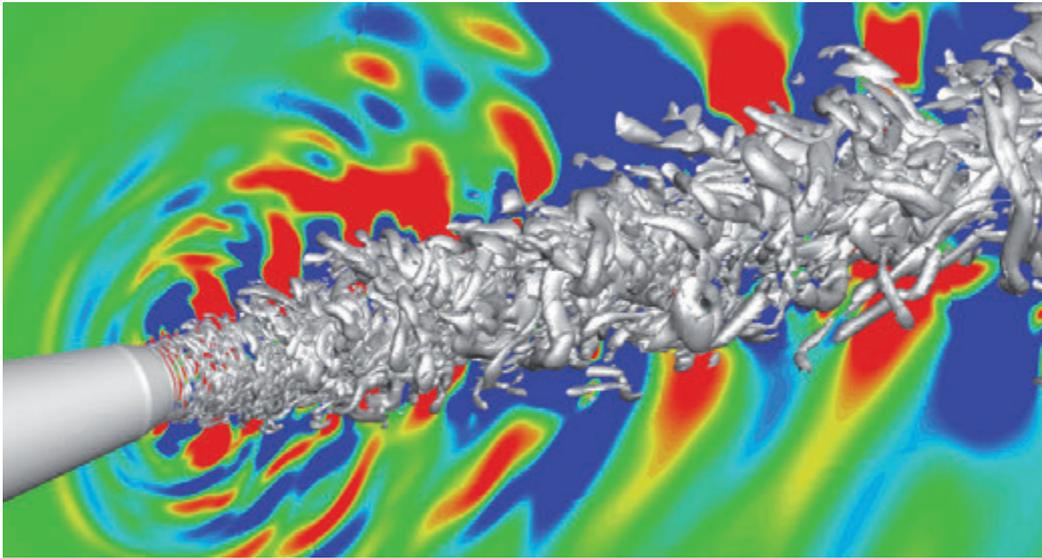
The 4th edition of the DGA Innovation Forum was held on November 26th at the Polytechnique. Ten projects and theses involving ONERA (almost 10% of the total) were presented at this meeting place for key players in defense innovation and research. ONERA presented its latest innovations, particularly its research project on surface wave radar, which is a means for more discreet and effective surveillance of maritime zones.



ONERA at COP21

On December 11th 2015, the Chairman of ONERA participated in the COP21 round table "Air transport and sustainable development: technological advances in the aviation industry". He was thus able to present the ONERA projects related to environmental issues and, more generally, remind that ONERA's mission is to support the industry of its sector helping it to prepare for the future.

ONERA a world leader in computational fluid mechanics



The ONERA digital simulation specialists participated in a workshop organized by NASA alongside the Annual Congress of the AIAA*. ONERA thus measured itself against the international state of the art in terms of accuracy and performance of numerical methods for aerodynamics. The results of the test cases confirmed that ONERA is a world leader.

* American Institute of Aeronautics and Astronautics



Bruno Sainjon elected president of the EREA

In December 2015, Bruno Sainjon, Chairman of ONERA, was elected president of the EREA (Association of European Research Establishments in Aeronautics) for a period of two years.

French-Russian collaboration ONERA-TsAGI

Aimed at rewarding and supporting a project conducted by a team of young researchers from TsAGI and ONERA, the ONERA-TsAGI award was presented for the 1st time at the 14th TsAGI-ONERA seminar. The winners were Ivan Kondakov and Yury Dymnikov of the TsAGI, and Cecile Davoine and Dimitri Bettebghor of ONERA. The subject of the project was: new aeronautical structure concepts in composites and bio-inspired meta-materials.



French-Singaporean collaboration

The chairman, Bruno Sainjon, travelled to Singapore for two days in February, at the invitation of the scientific advisor for the Ministry of Defense Mr Quek Tong Boon, who had visited ONERA last November. This visit enabled him to establish contacts with the Singaporean partners in the SONDRALIA alliance, the DSO and the University of Singapore. The exchanges with the DSO confirmed the continuity of the SONDRALIA laboratory and the potential start of new collaborations in robotics, drones, mini-satellites, etc.

* French-Singaporean research laboratory for optronics and radar



H2020: ONERA in the spotlight

The four research projects submitted by ONERA were selected. For two of them, ONERA has partnered with China: the DRAGy project on drag reduction and the IMAGE project on reducing noise and emissions. It is the leader of the two other projects: the EPICEA project with Canada on the electromagnetics of a more composite and more electric aircraft and the VISION project with Japan on navigation systems to improve airliner safety.



Contributing to the future combat air system

To face changing threats and in order to maintain its position of top level military power, France has launched, in cooperation with the United Kingdom, the FCAS¹ combat drone program.

Objective: to prepare the future of military aviation.

Alongside the government and industry, ONERA participates in the program by offering innovative solutions and using its test facilities.

¹ Future Combat Air System

² Direction Générale de l'Armement, the French government defense procurement and technology agency

In 2015, ONERA was contracted by the DGA² and industrialists to perform research work on several key aircraft subassemblies or systems:

- the platform afterbody, on which ONERA, with its vast experience acquired in the nEUROn program, will conduct architectural and cooling studies and tests seeking the best compromise between aerodynamics and stealth requirements;
- propulsion, for which ONERA's expertise in materials will be used for new developments on the hot parts of the engine; objective: to enhance their performance, particularly by optimizing the cooling of the turbine blades;
- the positioning of the drone relative to other aircraft, for example when refueling in flight, taking into account the constraints inherent to unmanned vehicles (interoperability, independence from the operator, etc.).

Thanks to the multidisciplinary nature of its professional trades, ONERA is able to mobilize a wide range of scientific expertise for the benefit of the program: fluid mechanics, physics, materials, or even information processing and systems. The complementarity between modeling, simulation and experimentation strengthens the expertise contributed to the program.

To contribute to the definition of future combat aviation, ONERA can also rely on the BLADE (Battle Lab for Aerospace and Defense Experimentation) simulation tool, which assesses defense systems in an environment that is representative of operational situations. A major asset for ONERA, demonstrating its ability to combine its cutting-edge scientific expertise in a system tool that provides an overview of the performance available.

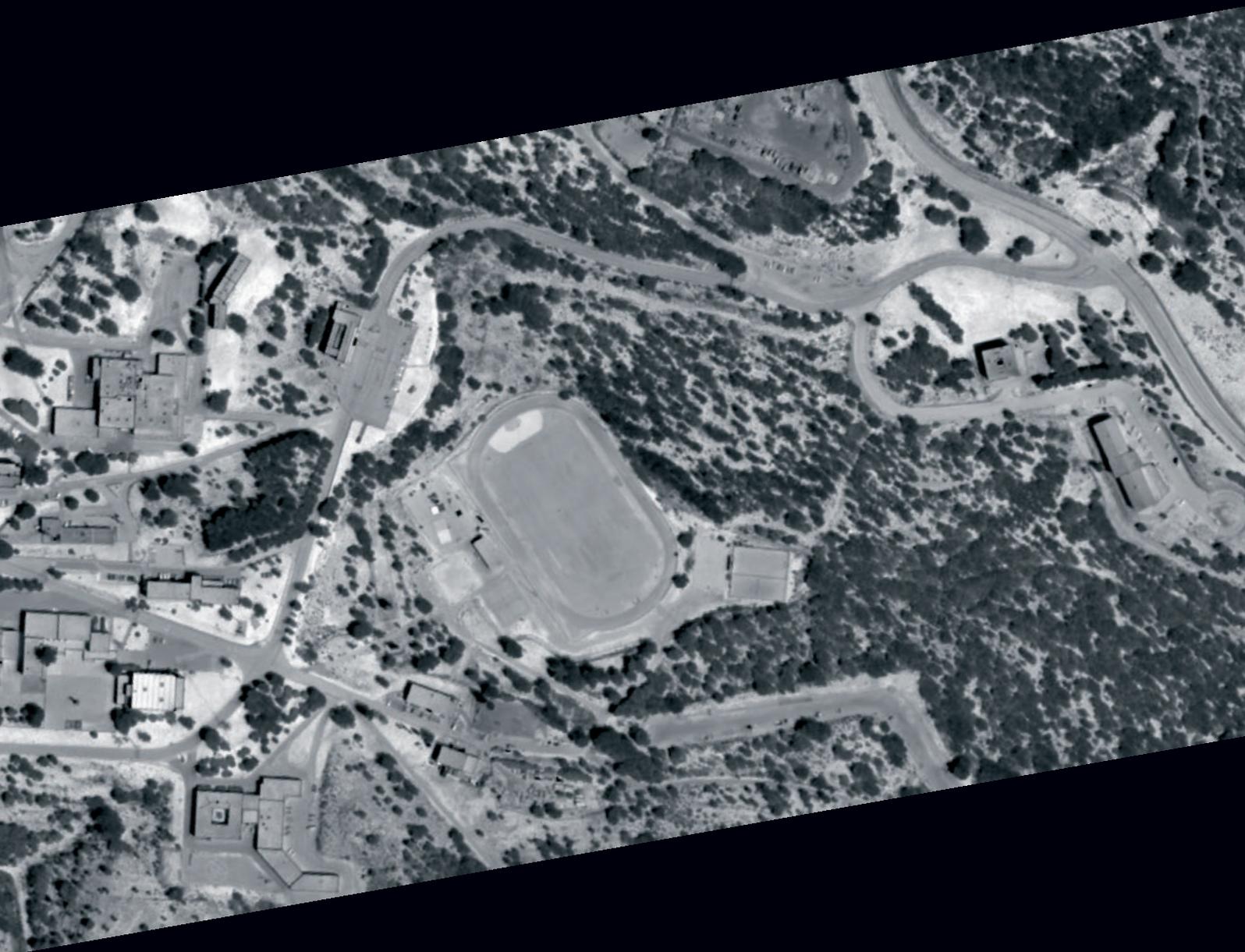


Model of the nEUROn in the F1 wind tunnel of the ONERA Fauga-Mauzac center



At the request of the DGA¹, ONERA has designed and developed the very high spatial resolution hyperspectral imaging system Sysiphe². The purpose of this reference system is to gather measurements that will enable the contribution of spectral imaging to defense to be assessed and will make it possible to determine the advantages of broadband high performance hyperspectral imaging compared to the performance of a traditional imager.





Preparing tomorrow's information systems

In August 2015, ONERA successfully conducted the first Sysiphe data acquisition campaign, on military scenarios developed jointly with the DGA.

Developed by ONERA, this airborne imaging system is unique in Europe: in its test configuration, it delivers very high spectral resolution (over 500 spectral bands) hyperspectral images, covering both the visible and the thermal infrared domain.

This Sysiphe data will validate the model codes developed by ONERA, as well as contributing to the specification and qualification of future information systems.

This spectral measurement capability will enable the refinement of the information gathered, improve target classifica-

tion, or even assist in foliage removal and de-camouflaging. The data gathered will be used as from early 2016, with the main objective of evaluating the contribution of spectral imaging techniques for the operational needs of the armed forces.

A second campaign carried out under different environmental conditions will validate the robustness of the analyses with regard to seasonal variations.

¹ *Direction Générale de l'Armement*, the French government defense procurement and technology agency

² Embedded spectral imaging system for the measurement of hyperspectral properties



ONERA has designed an innovative instrument for the absolute measurement of gravity, the result of extensive research and of its detailed knowledge of physics and mathematics.

Financed by the DGA¹, this atomic gravimeter is intended for naval applications and will, initially, enable the Navy to navigate without GPS. The first series of experiments revealed the full potential of this innovative instrument.

Navigating without GPS



In 2012, ONERA had developed a first laboratory demonstrator, GIRAPE, whose measurement accuracy was remarkable. To meet the specific needs of the Navy, ONERA developed a second atomic gravimeter demonstrator, GIRAPE 2, embeddable, capable of providing high accuracy measurement and insensitive to meteorological and oceanographic disturbances.

In October 2015, ONERA and the SHOM² successfully carried out two gravity mapping campaigns off the coast of Brest. On board the hydrographic and oceanographic ship *Beautemps-Beaupré*, the GIRAPE 2 demonstrator was able to provide an absolute measurement of gravity of unparalleled accuracy in harsh weather conditions.

This new success by ONERA confirms its know-how in terms of navigation instruments. ONERA plays its full part in bringing to maturity this new technology for the benefit of Defense and the industrial sector.

In addition to its applications for navigation without GPS, GIRAPE 2 will also be able to be used for the geophysics of ocean areas or the exploration of the seabed (ore, oil).

¹ *Direction Générale de l'Armement*, the French government defense procurement and technology agency

² Naval Hydrographic and Oceanographic Service



Drones

Appraising, developing and innovating

COMBATTING MALICIOUS DRONES

The year 2015 was marked by numerous overflights of sensitive sites by drones, bringing forth the concept of threatening or malicious drone. ONERA's scientific expertise in this area makes it the natural benchmark in the fight against drones.

The ANGELAS consortium, led by ONERA with six industrial and academic partners (Thales, EDF, Telecom Sud Paris, CEA Leti, Exavision and the Paris Institute of criminology), was selected by the French National Research Agency (ANR) in April 2015, as part of the "Protection of sensitive areas from aerial drones". Objectives: to detect, identify and neutralize malicious drones in various scenarios, combining various proven or breakthrough technologies (optronics, radar, acoustics and goniometry).

The International Symposium on Drones, organized by the French General Secretariat for Defense and National Security SGDSN (*Secrétariat Général de la Défense et de la Sécurité Nationale*) in June 2015, brought together the main representatives of the State, industry, research and users, to identify the first guidelines to be taken by the government. Thus, ONERA characterized the difficulty in detecting these malicious drones (small size, velocity, low altitude and low speed flight), and reported on its research and the technologies enabling these challenges to be responded to.



ONERA has been developing new technologies to secure the flight of drones and increase their performance for over 25 years. Today, this research brings together around a hundred ONERA researchers in more than 60 French, European or international projects. This "drone system" expertise is possible thanks to its multidisciplinary and its unique expertise in the development of sensors and the associated processing, embedded intelligence and, finally, through its ability to test the drones in real environments.

As government expert and supporting innovation for industry, ONERA is also an active member of the civil drone committee. It is therefore the preferred speaker for the players in the drone ecosystem: Institutions (DGA, DGAC), laboratories (ISAE-SUPAERO, ENEC, LAAS, CEA, INRIA, etc.), industrial drone manufacturers (Airbus, Dassault, Sagem, Thales, AJs, Delair Tech, Airborne Concept, etc.) and industrial heavy users (SNCF, RTE, EDF, etc.).

Some strategic lines of research developed in 2015

IMPROVING THE COOPERATION BETWEEN ROBOTIC AND HETEROGENEOUS SYSTEMS: THE ACTION PROJECT

Funded by the DGA and developed in cooperation with LAAS, this project explored innovative techniques for the cooperation of a team of heterogeneous autonomous drones (land, sea or air) for complex civilian and military tasks: locating and monitoring of objects (sea mines, wrecks, etc.), search and rescue missions, surveillance, exploration (ports, industrial areas, etc.), pollution control, etc. The project was presented at the UGS show in October 2015.

PARTICIPATING IN THE DESIGN OF DRONES AND INNOVATING DRONE SYSTEMS: THE DROSOFILS IRP

The purpose of this Industrial Research Partnership signed with the SNCF for a term of five years and a for the amount of four million euros is the development of innovating technologies and helping to design custom drone systems for monitoring the railway network and inspection of structures and facilities (railway stations, technical centers, canopies, art structures, trains, etc.).

IMPROVING DISPLACEMENT AND DECISION AUTONOMY: THE COPERNIC LAB

This laboratory is aimed at developing drone embedded intelligence and testing their perception and autonomous navigation capacity in indoor and cluttered environments.

In 2015 it enabled the qualification of a demonstration of microdrone control and automatic navigation without GPS, based solely on information from on-board sensors (stereo cameras and inertial measurement unit).

This expertise enabled the ONERA-RTE-UPMC-ISIR consortium to be selected in May 2015 as one of the top five on a European level in the EUROCC drone challenge (European Robotics Challenge).

ONERA-DGAC Renewed confidence

In 2015, the DGAC¹ gave ONERA many testimonies of its confidence in it, to reinforce its position as key player in its sector. The signing of four research agreements as well as the financial support provided to ONERA to maintain the level of its wind tunnels are proof of the willingness for both entities to cooperate closely.

COLLABORATION THROUGH RESEARCH

In September 2015, ONERA and the DGAC signed four agreements relating to research programs. Pursuant to the wishes of the CORAC² for the ONERA to lead the research for the better understanding of the complex phenomena related to aircraft environments, the DGAC contracted ONERA for three research programs worth 7 million euros over five years:

- PHYWAKE on wake vortices
- PHYSAFE on crashes
- PHYLIGHT on lightning

Funded 100% by the DGAC, this research will improve the understanding of physical phenomena and establish models validated by experience.

In December 2015, the DGAC continued support for ONERA by signing an agreement on icing and its consequences for aircraft. In order to take into account extreme physical phenomena, international regulations have evolved considerably, prompting authorities to turn to the experts in aeronautics research. Recognized internationally on the subject, ONERA thus signed the PHYSICE2 agreement following PHYSICE, on the modeling of the physical phenomena related to icing.

The agreement also includes funding for the creation of an experimental medium dedicated to ice only in Europe.

FINANCIAL SUPPORT FOR WIND TUNNELS

The DGAC granted ONERA two repayable advances amounting to 4,450 million euros under very favorable terms for significant upgrades of its main wind tunnels.

Indexed on the revenues of the wind tunnels concerned, they were the subject of two agreements.

NOVENS1MA consists in replacing the 22 blades of the two counter-rotating fan of the S1MA wind tunnel (the very large sonic wind tunnel at Modane-Avrieux). The new hybrid blades – steel + composite – will be installed in 2017. More efficient and with superior performance, they will better withstand extensive testing up to Mach 0.95.

MORPHO, amounting to 1.5 million euros, relates to the complete redesign of the wind tunnel information systems. The agreement will finance the deployment of a new information system for F1 (the large pressurized low speed wind tunnel at Fauga-Mauzac) and S2MA (the transonic and supersonic up to Mach 3.1 wind tunnel at Modane). The software architecture, defined together with the AKKA Technologies group through an ONERA investment, will completely change the interactions of the operators with the system.

This new computing system will facilitate the acquisition, processing, transfer and storage of test data: the ONERA systems, though fully operational, will be more suitable for new methods.

These agreements cover the first two projects in the ATP France plan to upgrade ONERA's wind tunnels.

¹ Direction Générale de l'Aviation Civile, Directorate General for Civil Aviation

² Comité pour la Recherche Aéronautique Civile, Committee for Civil Aeronautics Research

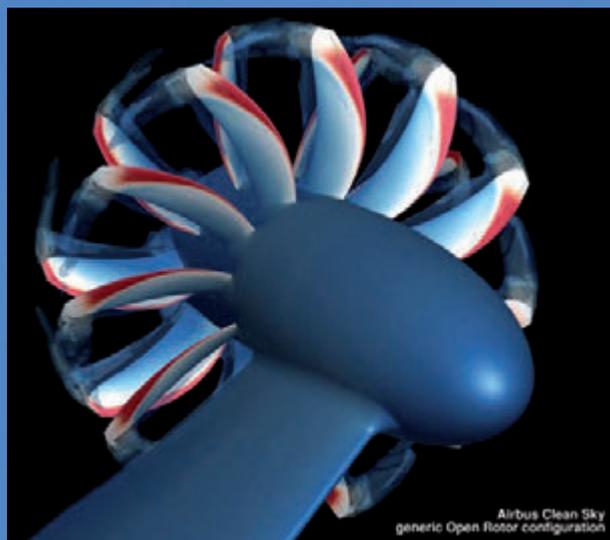




AIRBUS-SAFRAN-ONERA AGREEMENT FOR THE DEVELOPMENT OF THE SOFTWARE ELSA

A cooperation agreement was signed between Airbus, Safran and ONERA for the development of the aerodynamic software platform Elsa (a software package for simulation in aerodynamics). It sets a joint work framework, based on a permanent three-way cooperation and shared financing. The activities carried out under this agreement include applied research, the production of the software, its deployment in the simulation chains of the three parties to the contract, its validation and the support and maintenance. The work is mainly carried out by ONERA with the support of subcontractors for the most downstream activities.

This agreement especially illustrates the new working dynamics between ONERA and two of the major players in its sector, which thus recognize the contribution of its expertise and its tools.



FUTURE COCKPITS AND NAVIGATION: IN LINE WITH CORAC EXPECTATIONS

As part of the PIA 2¹, a call for tenders was launched in July 2015 for French aircraft manufacturers², assisted by other industry experts such as ONERA, to combine their expertise to accelerate the development and validation of new cockpit platform concepts and advanced functions. Nine ONERA research projects in optics, radar, information processing and even system controls and flight dynamics were selected.

On this last topic, the SEFA-IKky project (embedded systems and advanced features - Integration of the cockpit and its systems), which is aimed at improving the industrial processes leading to the certification of aircraft, will result in various types of software and code (sometimes embeddable). It is divided into several topics:

- improvement of in-flight test processing;
- improvement of the control software and the surrounding logic;
- improvement of sensor fault detection and development of more resilient systems.

This high TRL work is being carried out in response to the current challenges that aircraft manufacturers face. To carry them out, ONERA can rely on upstream research that it conducts in parallel with its applied research.



¹ The Future Investment Program, *Programme d'Investissements d'Avenir*, launched in 2013, following the PIA 1 launched in 2008 as part of the "Big Loan" government program for research.

² Airbus operations SAS, Dassault-Aviation, Airbus Helicopters, Thales Avionics

ONERA contributes to the industry its scientific expertise, its test facilities and its ability to conduct cross studies to help them to respond to the new challenges of air transport. Several agreements initiated in 2015 follow this direction.

Responding to industrial challenges



ONERA IS A MEMBER
OF THE NETWORK
OF 34 CARNOT
INSTITUTES



The Carnot Institutes are 10 years old!



Every five years, the Ministry of Research grants the Carnot label, pursuant to scientific expertise criteria, following a very selective call for applications. The Carnot Institute ONERA, which received the label in 2007 and again in 2011, demonstrated its ability to develop high level research partnerships for technology transfer to companies. On September 23rd, 2015, the network of Carnot Institutes celebrated its 10th anniversary in the presence of 100 guests, including representatives of the embassies of 15 countries, as well as a large number of institutional and industrial players. The proof that the Carnot system has become rooted in its political-economic environment and has emerged as an innovation pioneer in France.

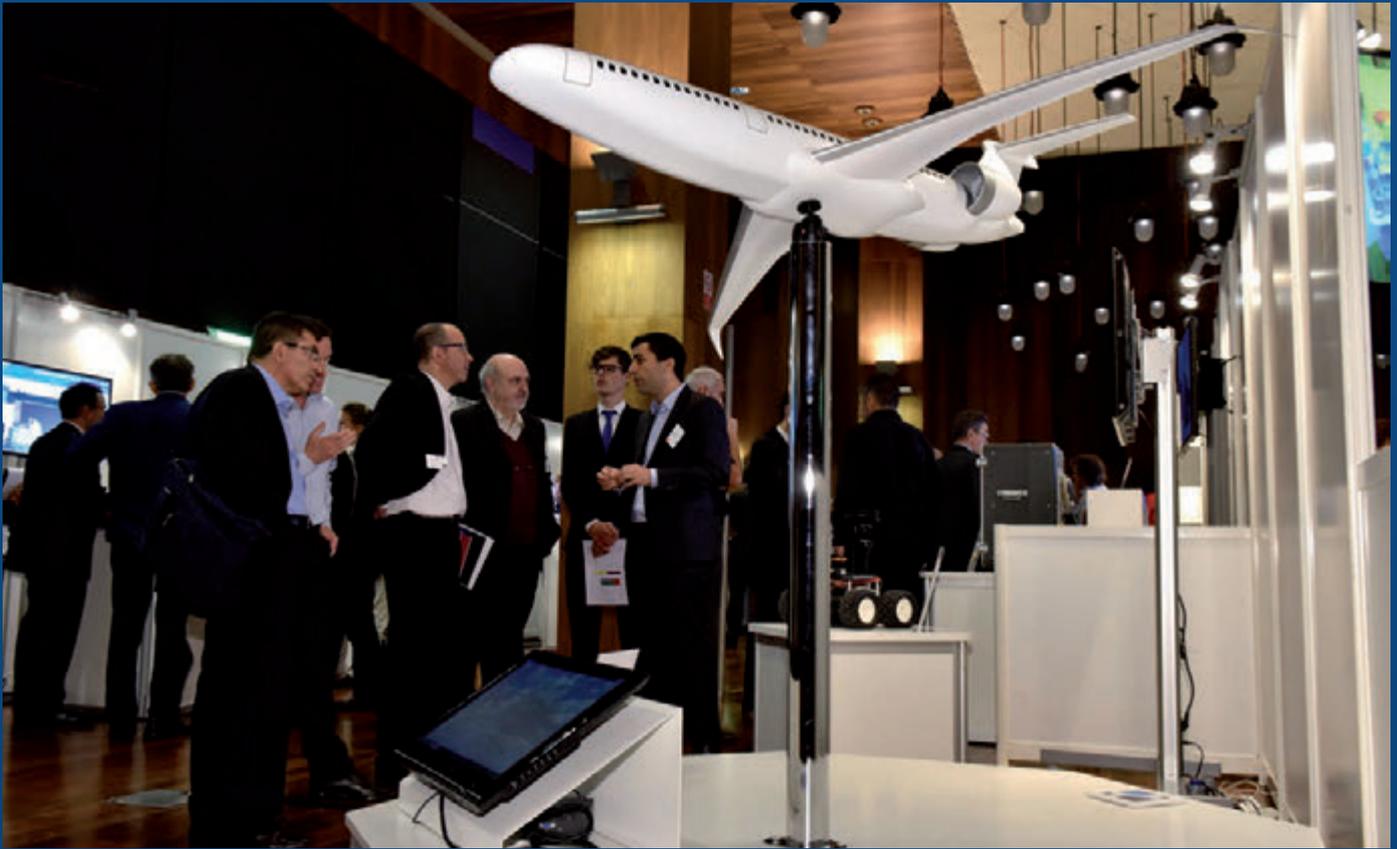
There were three speakers at the closing of the event, Louis Schweitzer, General Commissioner for Investment, Pierre Gattaz, Chairman of Medef and Thierry Mandon, Secretary of State for Higher Education and Research, who highlighted the network performance and the progress made over 10 years to bring public research to companies.

In order to pursue these actions, the Secretary of State announced the launch of the Carnot 3 call for applications, in November 2015.

The Carnot Institute ONERA was represented at the exhibition by the Nova model, an emblematic Carnot achievement, which could foretell what future aircraft will be like.

During the "Carnot International" round table, the Carnot Institute ONERA shared its successful experience at the Sondra laboratory with Singapore. Launched in 2004, Sondra conducts technological research activities on radar observation, combining wave physics and signal processing. Its establishment in June 2014 on the Saclay plateau strengthened its international visibility and opportunities for cooperation. In 2016, ONERA's objective is to earn the Carnot label again. More open to the outside and eager to bring to life nautical research using the richness of regional and national ecosystems, ONERA thus manifests its willingness to work in a network.





ONERA leads AIRCAR

The AIRCAR (Air Carnot) proposal, coordinated by ONERA, is the response of the Carnot Institutes to the needs of the aerospace industry. Developed under a call for future investment program projects reserved for Carnot Institutes, it was selected in April 2015.

Objective: to amplify the impact of the Carnot Institutes on the innovative capacity of French SMEs and medium sized companies by structuring the offer of CI skills and technologies to meet the needs of the industrial sectors.

As from the very beginning of the call for projects in 2013, ONERA proposed to be the convener of the Carnot Institutes likely to meet the needs of the aerospace industry.

It gathered eight other institutes around it: ARTS, CETIM, MINES, I@L, IPEN TE, MICA, CEA LETI and ESP.

The consortium has many advantages:

- a range of skills covering the technical and scientific needs of the sector: from traditional disciplines to the new topics of aeronautics;
- a multidisciplinary approach to the sector problems;
- a fine geographical network of the sector's employment areas. The State, through the General Commission for Investment, will fund the project for six years for up to 10.5 million euro.

AICAR is based on:

- the collective action of the Institutes to benefit SMEs and medium size companies in the aviation sector;
- governance associating the players involved (competitiveness hubs, GIFAS, etc.), taking into account their objectives and recommendations;
- the creation of "Carnot Aviation Industry" development officer positions in each territory related to aviation hubs, clusters and other stakeholders;
- mobilization – by dedicated funding – of competitiveness hub skills and the common organization of demonstrations for SMEs and medium size companies;
- visibility of the Carnot Institutes before the aeronautical industry and communication about its actions;
- enhancement of the attractiveness of the technical trades of aeronautics;
- financing of studies relating to the specific needs of SMEs and medium size companies.

For ONERA, coordinating AIRCAR is an opportunity to forge partnerships with other Institutes. It is also the promise of more technologies brought to maturity and transferred to SMEs and medium size companies, as well as an increased partnership and contractual activity between these companies and the AIRCAR institutes.

Academic partnerships: a guarantee of scientific vitality and opening up to the outside

Creation of two joint ONERA/ISAE research teams

Bruno Sainjon, Chairman of ONERA and Lesbre Olivier, General Director of ISAE-SUPAERO, signed on March 24th 2015 in Toulouse a partnership agreement creating two joint research teams (ECR). These ECRs develop, in particular, lines of research in the field of information processing and systems.

THE ECR "MODELING FOR SYSTEMS ENGINEERING"(MOIS)

The evolution of the complexity of aeronautical systems, coupled with their criticality, requires their design to be carried out in a formal setting, to facilitate their certifiability and to optimize their performance and cost, while ensuring their functional and non-functional properties. By combining the scientific expertise of ISAE and ONERA in the complex areas of systems engineering, the MOIS ECR has a research and development potential that is unique in France.

THE ECR "SYSTEM CONTROL AND FLIGHT DYNAMICS"

It focuses on the research and design methods for new aerospace vehicle architectures, as well as those for space intervention means. The scientific and technical challenges relate to the structural design, propulsion and control of human-system interfaces. Objective: to accelerate research in these areas and organize the joint experimental research means to increase efficiency and visibility.



In 2015, ONERA solidified its relations with various research actors through partnerships with great engineering schools and research organizations.

Objectives: to simplify collaboration between researchers, developing lines of research in advanced fields and seeking new customers, with the aim of strengthening ONERA's position as a major player in aerospace research.

The focus is on three emblematic partnerships.

First recipient of the European Research Council award at ONERA

Olivier Marquet, a research engineer in the fundamental and experimental aerodynamics department is the recipient of the European Research Council (ERC) award, Starting Grant category, for his project AEROFLEx. The ERC supports high-level research in Europe by funding researchers



in all scientific disciplines. There is a single selection criterion: excellence of the scientific project, which must be a breakthrough relative to existing technology and put forward by a young researcher with strong potential. Olivier Marquet, who competed with over 3000 candidates, is one of the 375 elected, who each have just been granted around 1.5 million euro to complete their project. "The idea of AEROFLEx is to use the instabilities of wings immersed in a fluid to reduce their resistance to drag. I will develop new methods to study these instabilities, without separating the fluid from the structure a priori. This will allow me to extend the analyses to controlling fluid flows in aeroelastic problems" he says. This basic research, with a duration of five years, should lead to innovations in aerodynamics, aero-elasticity and flow control.

Creation of MINAO, the ONERA-CNRS micro-nano-optics laboratory

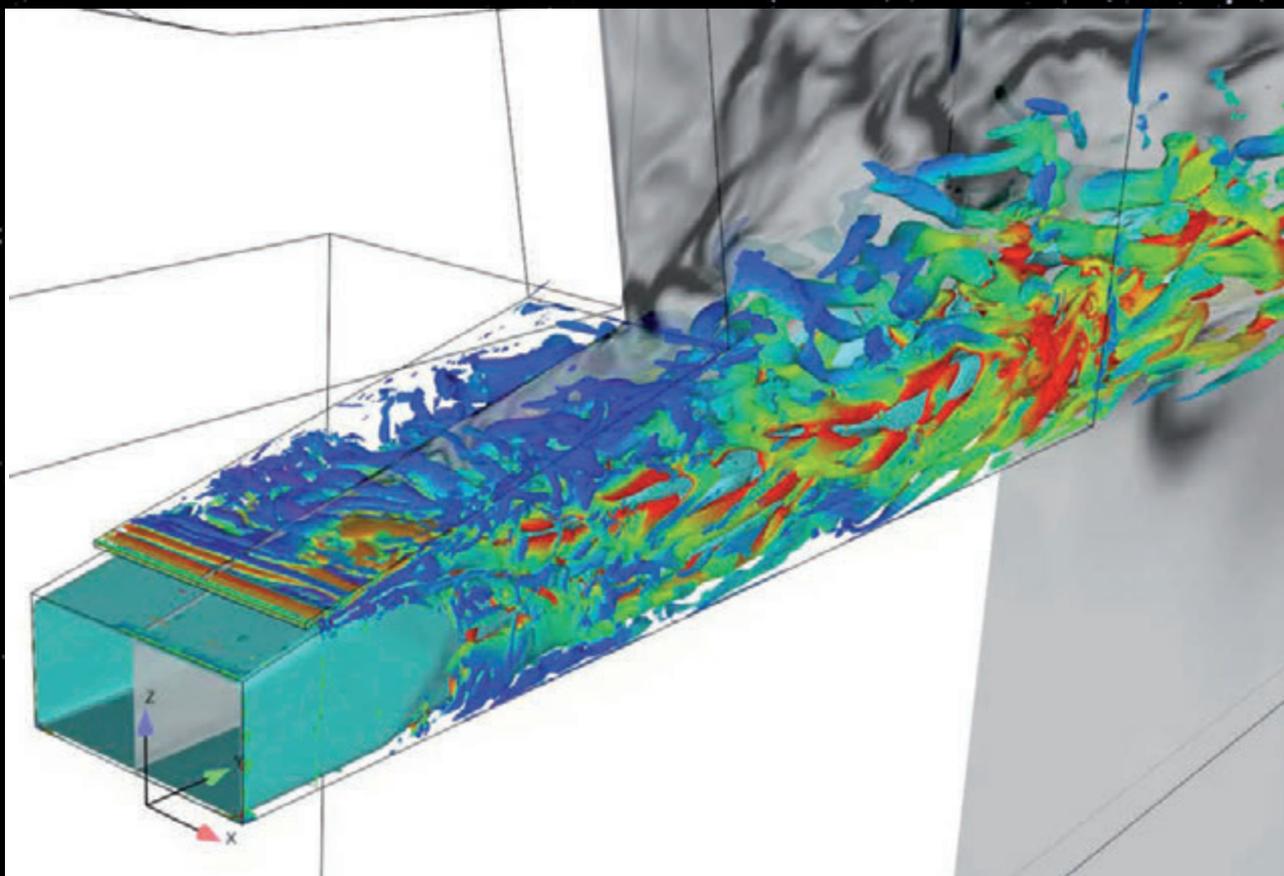
In March 2015, Bruno Sainjon, Chairman of ONERA, and Philippe Cavalier, *Île-de-France-Ouest et Nord* regional delegate of the CNRS, signed an agreement for the creation of a joint research laboratory: MINAO (Micro-NANO-Optics). It embodies ten years of joint scientific research between ONERA's Theoretical and Applied Optics Department (DOTA) and the Photonics and Nanostructure Laboratory (LPN) of the CNRS. It strengthens the exchanges to form a joint proposal force on nanotechnology applied to optoelectronics.

It is a structure integrated by twenty people, based on the synergy of scientific expertise and technical resources. Its activity already includes numerous publications and around ten patents, valorized through several national and international contracts. MINAO has a unique offering that combines the rather fundamental sensitivity of the CNRS and ONERA's more applicative approach, pursuing sustained R & D activity, to propose offer technical solutions to industries requiring compact energy efficient and embeddable systems, with restricted costs. MINAO may well go to meet can thus reach out to new customers and partners. The applications aimed at are military and sometimes dual (gas analysis, precise remote temperature assessment in medical biology analyses, high efficiency solar cells, or combatting counterfeiting, etc.).



Stronger collaboration with the CNES

Given the rapidly changing space industry, the French sector must be responsive and adapt to changes in the sector to maintain its excellence and global competitiveness. The CNES and ONERA, historical partners, reaffirmed their collaboration in 2015.



To meet the commercial and sovereignty challenges of the space sector, the CNES has always turned towards ONERA, whose expertise and innovation solutions contribute greatly to preparing for the future. They are indeed preferred partners for applied space research, such as, for example, their current collaboration on reusable launchers.

In 2015, the CNES and ONERA formalized ten Common Interest Programs (PIC): an important milestone that reflects the strengthening of their cooperation.

On the topic of launchers, seven PIC require the following ONERA fields of expertise:

- instabilities;
- flow through nozzles;
- heat transfer in combustion chambers;
- simulation of the launcher jet noise;
- composite structure design;
- launcher steering;
- pressure oscillations.

The CNES and ONERA also decided to work together on reusable launchers and especially on the re-entry of the 1st stage. A first study was launched in 2015: the conclusive results led to the pursuit of further cooperation in this field. On the topic of orbital systems, three PIC were launched in 2015 in the following fields:

- system control and robotics;
- electromagnetic propagation;
- modeling of debris atmospheric reentry.

On the occasion of the signing of the framework agreement between the CNES and ONERA, in March 2015, Jean-Yves Le Gall, Chairman of the CNES, stated: "In a context of strong competition, the CNES and ONERA have decided to pool their skills (...), making the most of the cooperation between our two institutions." This view was reaffirmed by Bruno Sainjon, Chairman and CEO of ONERA, in whose opinion: "this framework agreement strengthens our common action in the three fundamental areas: launchers, orbital systems and scientific missions."

ONERA is preparing Europe's future small satellite launches

In a context of an emerging market for small satellites, ONERA launched the European project H2020¹ ALTAIR², to demonstrate the industrial feasibility of a low-cost small satellite launch system.

Its multidisciplinary approach and its ability to address cross-functional issues make it relevant on the subject yet again.



The miniaturization of components for small satellites, and the rise in power of mega-constellation projects, for example, telecom or Internet, pave the way for marketing small satellites. In this context, the ALTAIR project proposes an innovating launch system solution for small satellites³. It is a reusable "airborne launch" type of system, in which the carrier is a reusable automated aircraft, dropping an expendable launcher at high altitude.

The launcher will use an environmentally friendly hybrid propulsion, a high performance composite structure, innovative avionics and a top stage providing mission flexibility. The architecture of the ground systems will be simplified and will render operations more economic.

ONERA, which has dual competence in space and aeronautics, is coordinating the project involving eight partners⁴ from six countries.

The system design will benefit from the multidisciplinary design/optimization methods (MDO) developed at ONERA for over ten years.

In addition, flight tests will be conducted with the existing demonstrator Eole (developed under the supervision of ONERA for the PERSEUS project of the CNES), in order to validate key technologies for the launcher avionics and its release sequence.

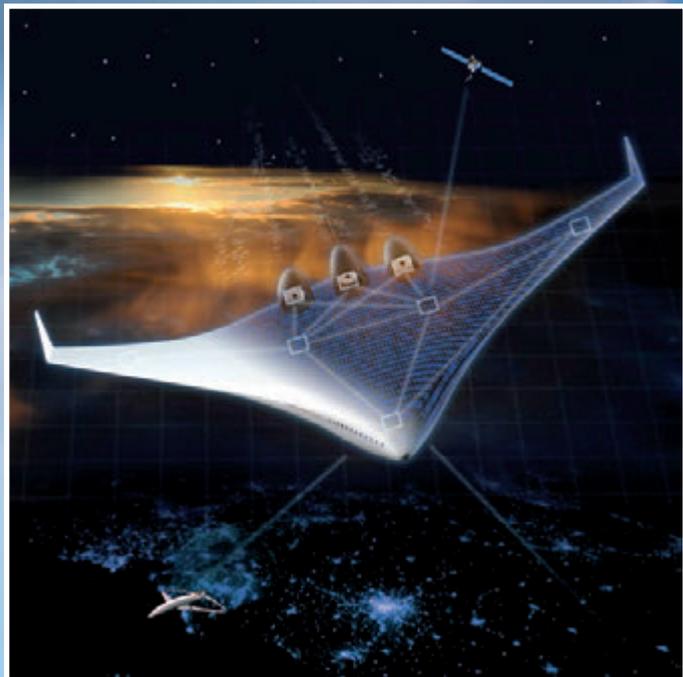
Funded by the European Commission to the tune of 3.5 million euros and by Switzerland to the amount of 0.5 million euros, the project, lasting 36 months, will result in a detailed definition of the complete system (carrier, launcher and ground segment) associated with a business plan and a road map and industrial organization proposal.

¹ H2020 = Early 2020 is the research and innovation funding program of the European Union

² Air Launch Space Transportation using an Automated Aircraft and an Innovative Rocket

³ Satellites in the range of 50 to 150 kg in low orbits at altitudes between 400 and 1000 km.

⁴ ONERA's partners for the ALTAIR project are: Bertin Technologies (FR), Piaggio Aerospace (IT), GTD Sistemas de Información SA (SP), the Swiss Federal Institute of Technology Zurich (CH), NAMMO Raufoss AS (NO), SpaceTec Partners (BE) and the CNES (FR).



Long-term multi-disciplinary planning anticipating aerospace breakthroughs

What will the aircraft of the future be like? Will they still use kerosene or will they all be electric? Will they fly faster? Or slower? Will the sky one day be reserved for defense only? What technologies will be needed for the survivability of future combat aircraft? This is just a sample of the many questions addressed by the long-term aerospace planning department (DPRA) to anticipate major changes and breakthroughs, to enlighten ONERA with regard to the research that must be prioritized, to thereby meet the future needs of the aerospace industry.

As a key ONERA mission entrusted to the DPRA in 2004, the multidisciplinary long-term planning complements the scientific long-term planning "by field", which is naturally carried out in ONERA's departments. To ensure this, the DPRA is developing a specific collaborative approach based on crossing trades. This approach encourages creativity, facilitates the emergence of different, even iconoclastic, points of view and instills the culture of a global vision and the ability to project in the long term.

For each question, the DPRA creates a multidisciplinary work group composed of experts. These integrated teams explore the range of possibilities, evaluate potential technical solutions and formulate reasoned recommendations on the positioning of ONERA, the orientation of its research, its organization, its collaborations and a roadmap.

To form these groups, the DPRA mainly draws from ONERA's pool of experts, which substantially capitalizes all aerospace disciplines. It also seeks the views of industry experts and of other research institutions or learned societies. The long-term planning on the flying wing concept was thus enriched by the experience of industry experts. Following this study, ONERA launched a

research project aimed at developing a structuring expertise and resolving uncertainties regarding the interest of this concept for the commercial transportation of passengers, while increasing the maturity of the technological components useful for industry.

The DPRA also gathers partners for joint long-term planning. Thus, it has formed a joint group with the Commission for Atomic Energy and Renewable Energy to explore the potential of all-electric aircraft. This study has demonstrated the value and feasibility of regional aircraft with distributed electrical propulsion and hybrid energy sources. Following the recommendations of this study, ONERA launched the AMPERE project to raise the risks related to aircraft configurations and the related technologies.

The DPRA is an original decision support tool, with specific means, for a key ONERA mission. It draws its potential from crossing the expertise in the aerospace, military and civilian fields. Its added value is to explore possibilities without preconceptions and completely independently, to discern among the needs those that should be translated into upstream research to anticipate breakthroughs and prepare for the future

ONERA's technologies swar



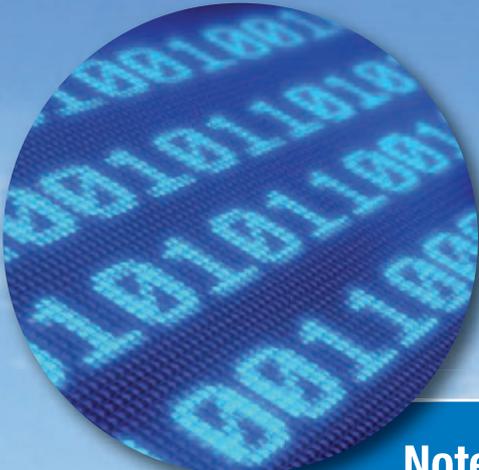
As a result of the future investment program (AIP), the SATT (technology transfer acceleration companies) maximize the social-economic impact of academic research results and promote job creation in France, while facilitating and accelerating the transfer of technology from public research to businesses.

Established on July 16th, 2014, the Paris-Saclay SATT matures, promotes, transfers and accompanies technologies and expertise from the laboratories of the Paris-Saclay University, which includes nineteen research players, including ONERA, which is a founding member.

In 2014, the Paris-Saclay SATT launched a call for projects with a budget of 5 million euro.

Of the 33 projects submitted, 8 received funding, including 3 implementing ONERA technologies. A success to the credit of ONERA's scientific excellence and its ability to valorize the results of its research. This success is also rooted in the synergy between people and means that ONERA has established between its researchers, its business management valorization team and the SATT teams.

The approach gives new visibility to ONERA's activities and arouses the interest of new partners. Contributing to business success, through these technology transfers, ONERA has put down its roots in the Paris-Saclay science and technology center and has solidified its role as a key player in the development of scientific research.



Notecsia: the power of scientific computing at the service of industry

The result of the most advanced research in the field of applied mathematics, the NumWorks calculation engine solves physics wave equations with a spectacular speed.

Applied to high frequency electromagnetic wave scattering problems, the engine is for example ten times faster than the best commercial software.

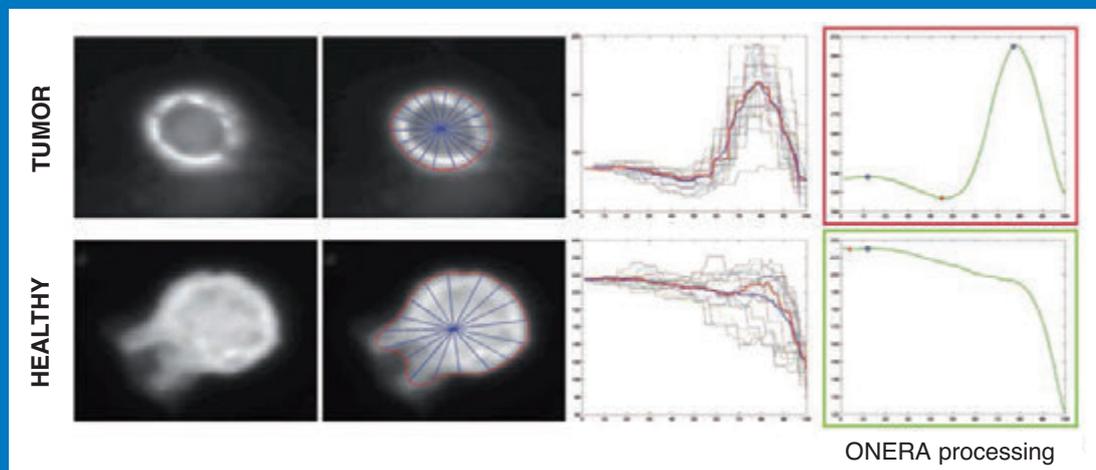
The project is aimed at making NumWorks a unique product on the electromagnetic simulator market. The SATT funds the work that supplements this computing technology, mainly the development of an ergonomic man-machine interface, in order to create a marketable calculation tool.

A scientific, technological and human adventure which should lead to the creation of a start-up.

m over the Saclay plateau!

Fluoalgo: an innovative process designed to help the early detection of cancers

The challenge is to aid in the diagnosis (or screening) of low grade bladder cancer by non-invasive means with a high level of performance. At the beginning of the project, a start-up, VitaDx, asked ONERA for its expertise and skills in automatic processing applied to biomedical imaging. Objective: to develop fully automated software to aid the physician in the diagnosis. ONERA will lead the engineering part of the project and the partner SME will lead the clinical trials.



MORPHEE+: ONERA's radar expertise at the service of the dependent elderly

The aim is to create a micro-Doppler sensor for the company Cerig, which works with 350 accommodation facilities for elderly dependents EHPAD (*Établissement d'Hébergement pour Personnes Âgées Dépendantes*) and which sought ONERA for its radar expertise.

ONERA and the company Cerig expect the system to:

- improve the safety and well-being of the residents;
- identify, by actigraphy, precursor clinical signs of certain diseases.

To achieve these objectives, three priority functions will be focused on: all detection, general actimetry measurement and respiratory rate measurement in a person lying down.



For more than twenty years, and now more than ever, ONERA's work totally fit in with the research programs of the European Union.

ONERA is thus a partner in the European collaborative research project H2020 on the topics of aviation, space and security. It is also a partner in the program "Future Sky" – Safety.



H2020 is the new European research and innovation funding program. It started on January 1st 2014, for a period of seven years. With 79 billion euros for 2014-2020, it brings together the research and innovation programs of the European Union and covers the entire innovation chain, from the idea to market.

ONERA IN CLEANSKY 2, THE AVIATION SECTION OF H2020

ONERA is very involved in the European program Cleansky 2, which was launched in 2014. The goal is to lay the foundations for an innovative Air Transport System based on advanced technologies and demonstrators. The main objective: the reduction of the environmental footprint of aviation. ONERA is thus associated in several platforms:

- "Large Passenger Aircraft" Innovative Aircraft Demonstrator Platforms, on par with the DLR, with funding of 30 million euros;
- "Green Regional Aircraft" Innovative Aircraft Demonstrator Platforms, with its Italian partner CIRA;
- "Airframe" Integrated Technology Demonstrators



ONERA, a recognized pla

WINNING EUROPEAN PROJECTS AND COLLABORATING IN INTERNATIONAL PROJECTS

Within the framework of H2020, in 2015 ONERA submitted four projects for the latest European calls for international cooperation. They have all been selected and will receive funding. ONERA is thus:

- a partner with Japan in the "SUNJET II" program (Sustainable Network for Japan-Europe Aerospace Research and Technology Cooperation II);
- a partner with China in the IMAGE program (Innovative Methodologies and Technologies for Reducing Aircraft), on reducing noise and emissions;
- coordinator, with Japan, of the VISION program (Validation of Integrated Safety Enhanced Intelligent Flight Control), on navigation systems to improve the security of airliners;
- coordinator, with Canada, of the EPICEA program (Electromagnetic Simulation and Modeling Tools for Composite Aircraft), on the electromagnetics of a more composite and more electrical aircraft.

ONERA AT THE CORE OF EUROPEAN SPACE RESEARCH

In March 2015, together with the main European research organizations, ONERA laid the foundations for an association of European space research organizations, like the one that exists in aeronautics (EREA). The CIRA, DLR, INTA, NLR and ONERA thus are demonstrating their willingness to strengthen their cooperation in the field of space R & T. Objective: to lay the foundations for a sustainable space industry, where technological excellence and competitiveness should be considered in the long term.

Lastly, since December 2015 and for three years, ONERA has been coordinating the ALTAIR project, a European H2020 project that gathers six partner countries. The challenge is to demonstrate the feasibility of a low cost small satellite industrial launch system.



leader in European research

ONERA centers are well rooted into

The Lille and Midi-Pyrénées centers interact with their academic and institutional environment, with a great challenge: valorizing ONERA's aerospace research potential throughout the country. Local relations, which each of the two centers has woven with the region, constitute a real asset to achieve this.

IN 2015, THE ONERA CENTER IN LILLE UNDERTOOK VARIOUS SCIENTIFIC AND MEDIA DIFFUSION ACTIONS

ONERA contributed to the development of the Elsat 2020 project, which is part of the State-Region project contract (CPER) 2014-2020 and deals with eco-mobility and transport, which are topics of excellence for the region. In particular, they involve continuing to structure regional research, in order to develop the greenest and safest future vehicle.

ONERA will play its part in this project in the areas of rapid structural dynamics and fluid mechanics. The "CONTRAERO" wind tunnel platform, implemented during the previous CPER as part of the CISIT (International Campus for Transport Safety and Intermodality - www.cisit.org), which defines a general framework for cooperation between the main aerodynamics laboratories of the Nord-Pas-de-Calais region on the topic of flow control, will be widely sought.

The ONERA Lille center has also multiplied its actions towards the general public, opening its doors to visitors for the first time in thirty years on the occasion of the science festival. An operation that has attracted the interest of local media.



their regional environment

ONERA, A "CONSOLIDATED ASSOCIATE" OF THE MIDI-PYRÉNÉES UNIVERSITY OF TOULOUSE (UFTMIP)



In 2015, the respective boards of ONERA and the UFTMIP voted in favor of a "consolidated" association. The members of the UFTMIP include the CNRS, the four Toulouse universities the INSA and the ISAE. This status, shared with other schools or university institutes in the region, enables ONERA to sit on the board of the UFTMIP. It opens up promising prospects for the development of shared research activities coordinated with the research units of these universities and schools. With the ISAE and the ENAC, also consolidated associates of the UFTMIP, a competence hub fully dedicated to the future of aeronautics and space was thus constituted within the Federal University.

TERRISCOPE, AN AIRBORNE IMAGING PLATFORM TO BENEFIT CIVIL SOCIETY

A research platform dedicated to the airborne imagery for the study of the environment and territory, the objective of Terriscope is to promote the development of services based on airborne remote sensing. Primarily funded by the Languedoc-Roussillon Midi-Pyrénées region and ERDF¹ funds from the European Union, the use of this platform is based on a synergy of skills and resources between ONERA and SAFIRE², a public instrumented research aircraft operator.

Beyond the one-off applications related to the environmental field, Terriscope will be particularly useful for gathering data over large areas and/or areas with complex geometry (metropolitan dynamics, functioning of large agricultural and forestry operations and natural resource management). The inspection of extensive industrial and civilian infrastructures (production sites, large lines, or large buildings) is also one of the main application areas foreseen.

Terriscope combines two fixed wing UAV platforms with a set of low energy compact sensors. The platform will in particular work with LIMA, the ONERA laboratory for the use of remote sensing data, also developed with the support of the Midi-Pyrénées region, the City of Toulouse and ERDF funding in 2013.

The developments will start in January 2016 for a period of three years. The means used are common and will be available to the regional and national scientific and industrial community.



¹ European Regional Development Fund; a European structural fund aimed at strengthening the economic and social cohesion by correcting regional imbalances.

² A French environmental research instrumented aircraft service; a mixed service dependent from Météo France, the CNRS and the CNES.



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