NLR - The Knowledge Enterprise for Innovation in Aerospace




NLR
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The National Aerospace Laboratory (NLR) is the main knowledge enterprise for aerospace technology in the Netherlands. NLR carries out commissions for government and corporations, both nationally and internationally, and for civil and military aviation. The overarching objective is to render aviation safer and more sustainable and efficient. In this way, NLR has been making essential contributions to the competitive and innovative capacities of Dutch government and industry for more than 90 years.

***NLR** - Dedicated to innovation in aerospace*

www.nlr.nl

NLR DEDICATED TO INNOVATION

How can aircraft become more quiet, more fuel-efficient and safer, and at the same time, how can capacity on the ground and in the air be expanded? And how can satellites help the aircraft fleet operate more efficiently and environmentally friendly? The National Aerospace Laboratory (NLR) is engaged with societal issues.

Collaborating in a more sustainable, efficient and safer aviation and aerospace sector: this has been the NLR's objective for more than 90 years. Whether it is about new, lighter – but super strong – materials or measuring the ash clouds from Icelandic volcanoes, the NLR is there. By developing market-focused products and services, NLR delivers a valuable contribution to strengthening the innovative and competitive capacities of the Dutch government and industry.

From smart ideas to products

NLR brings its knowledge to market, offering products with the best price/quality ratio. In aviation and aerospace innovation – from smart technological ideas to marketable products. This presupposes close relations and collaboration with industry.

For innovations in aviation and aerospace, NLR supplies knowledge to the so-called 'Golden Triangle', in which research, government and industry are allied. NLR is therefore closely allied with the top sector 'High Tech Systems and Materials', engaged in bolstering the Netherlands' ambitions with regard to innovations in the aviation and aerospace sector. NLR is also allied with the top sector 'Logistics' for the social theme mobility.

Upcoming countries

NLR is increasingly involved in activities in emerging economies. For example NLR has developed an aerodynamic wing design for the Brazilian aircraft manufacturer, Embraer's ERJ-190, a regional jet. The design was subsequently verified in German Dutch Wind tunnels (DNW). NLR also designed and produced a wind tunnel model for Embraer that was also tested in the wind tunnel.

"OUR MISSION: A MORE SUSTAINABLE, EFFICIENT AND SAFER AVIATION AND AEROSPACE SECTOR"

THE CESSNA CITATION II PH-LAB
a research aircraft jointly operated by
NLR and Delft University of Technology

International clients

Seventy-five percent of our turnover derives from contracts from the Netherlands and other countries. Together with Fokker and other companies, NLR for example develops applications of new, sustainable and lightweight aircraft materials, such as composites and fibre-metal laminates. NLR conducts safety studies for airports, ranging from Amsterdam Airport Schiphol to Taiwan Taoyuan International Airport. We tested all models of Airbus' aircraft in our wind tunnels, and in addition to Airbus, our clients include various other aircraft manufacturers, such as Boeing, Lockheed Martin, Embraer and Bombardier.

NLR and Europe

NLR collaborates with European organizations in the development of other shared systems for European aviation, such as in SESAR (Single European Sky ATM-Research). NLR also participates in Clean Sky. Clean Sky is currently the most important European joint venture focused on developing innovative sustainable aircraft technologies for use in the near future. Dutch industry, SMEs, universities and NLR are participating in this project, which ultimately aims to make European aviation highly competitive.
The knowledge that NLR contributes to international projects is partly intended to provide answers to inquiries from the Dutch government and industry.

Our mission

Helping to make aviation and aerospace more sustainable, efficient and safer, both nationally and internationally: that, in short, has been NLR's mission for the more than 90 years.

CIVIL AVIATION

The world is in continuous change and in this people and technology play an important role. The challenge for aviation is to expand capacity, while making flying even safer and protecting the environment.

NLR's focus for civil aviation is on providing operational and practical products and services, such as warning and advisory systems for air traffic control. And also on advising for improvements in aviation safety and airport operations. In this, NLR is completely aligned with the aviation sector's need for a sustainable, safe and competitive aviation transport system.

Air Traffic Management

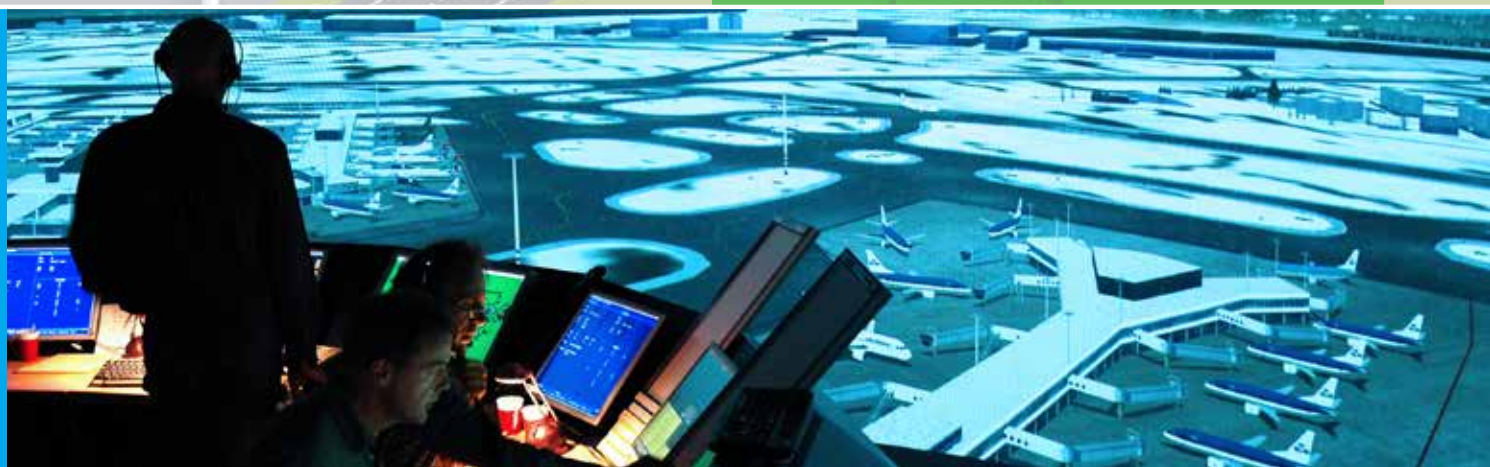
NLR has extensive modeling capabilities for improving Air Traffic Management (ATM) processes, airport operations and processes for airlines. Another area of NLR research is on how information exchange on weather conditions, flight plans, gate management and other relevant factors can be taken into account.

NLR conducts experiments with new equipment, to allow air traffic controllers identify potential conflicts quicker and to demonstrate how these conflicts can be solved best. Together with air traffic controllers, NLR first tests these innovations in simulators.

ATM Master plan

In the European context, NLR works on ATM. SESAR is the major European ATM research program. SESAR stands for Single European Sky ATM Research and provides support to the EU's ATM Master plan, aimed at ultimately creating a new European ATM system with associated procedures. In a consortium with LVNL (Air Traffic Control the Netherlands), NLR works towards the realisation of the Single European Sky.

NLR conducts research aimed at supporting and improving operations at airports, using collaborative processes involving the various parties to further improve the situation at the respective airport, with a good example of this being adaptations made to aircraft arrival and departure management.



Environment

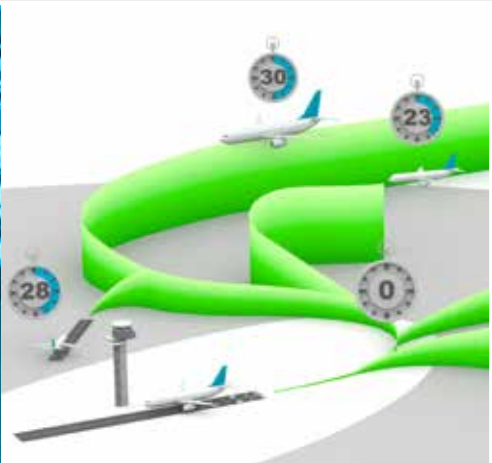
The Netherlands is one of the most densely populated countries in the world, and has as such a leading role in developing aviation environmental policy. NLR develops computer models to precisely measure noise disturbance levels. NLR's measurement methods are now the regulatory standard for Dutch aviation. As a consequence of these measurement methods, airports around the world now use these noise and risk contours. NLR also works on new flight procedures, such as Continuous Descent Approaches (CDA's), the so-called 'gliding flights' in which aircraft, with their engines idling, approach an airport in a low-noise, energy-saving gliding flight. In this, NLR contributes to Mainport Schiphol's aim to handle more air traffic while adhering to the established noise level standards.

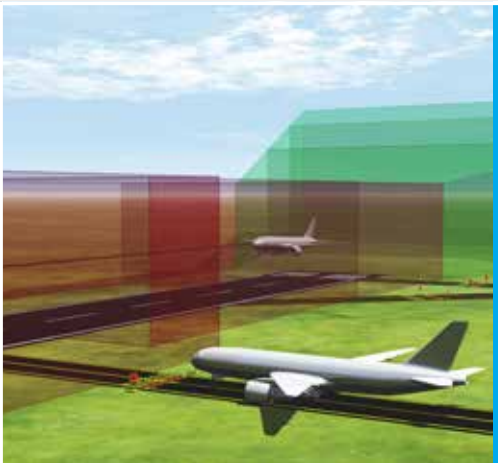
Safety

The number of flights double every 12 years, and every ten years the number of aviation accidents are reduced by half. More traffic on the ground and in the air, yet safety levels continue to improve: this doesn't happen by itself. NLR's Air Transport Safety Institute (NLR-ATSI) develops and applies world-class knowledge and expertise for improving safety. The new technologies and operations needed for sustaining growth in air traffic can have major consequences for safety. NLR-ATSI supports its stakeholders in this. By working for clients across the world, and by participating in international committees and working groups, NLR-ATSI is a recognized international knowledge centre for aviation safety.

Air Traffic

Air Traffic Control the Netherlands (LVNL) and NLR have developed a warning system for Schiphol's air traffic control tower. This 'Runway Incursion Alerting System Schiphol' (RIASS) functions as an important extra safety net for preventing runway incursions from occurring at Schiphol airport. RIASS warns air traffic controllers in the control tower for potentially dangerous situations involving aircraft or vehicles accessing take-off or landing runways that are in use. Such situations are called runway incursions. NLR and LVNL jointly developed the RIASS prototype, which was extensively tested in NLR Air Traffic Control Research Simulator NARSIM.





"NLR'S STRENGTH IS IN PROVIDING INTEGRAL SOLUTIONS"

INDUSTRY: CIVIL

NLR, as a knowledge institute, contributes to the innovative capacities of the Dutch and international aviation industry. NLR's strength is in providing integral solutions. Owing to our vast knowledge and know-how, NLR is involved in all stages of the aircraft development process. Our activities range from CFD calculations and the design and construction of models that are tested in our wind tunnels, to the validation of the models in our air traffic simulator, GRACE. This broad, chain-like approach makes NLR one of the unique organizations in the world, where research consists of all elements of aircraft development: aerodynamic and structural design, avionics design, man-machine interface, new materials (composites, Glare (R)) validation (wind tunnel tests, flight testing, structural tests, electronics tests), up to including Training, Simulation and Operations

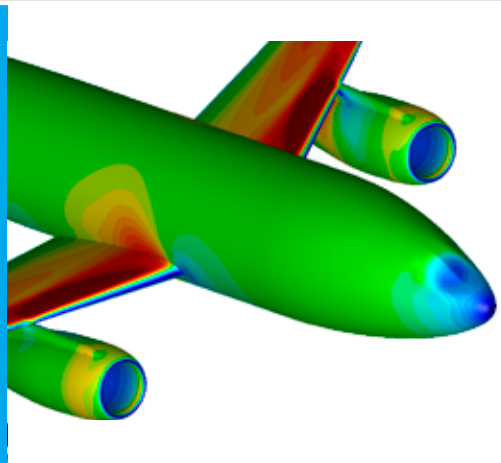
By focusing on operational, practically applicable products and services, and through consultancy activities pertaining to aircraft development and operational supplementation (for example MRO (maintenance, repair and overhaul), NLR strives to fully meet the airline industry's need for sustainable, safe and competitive aviation.

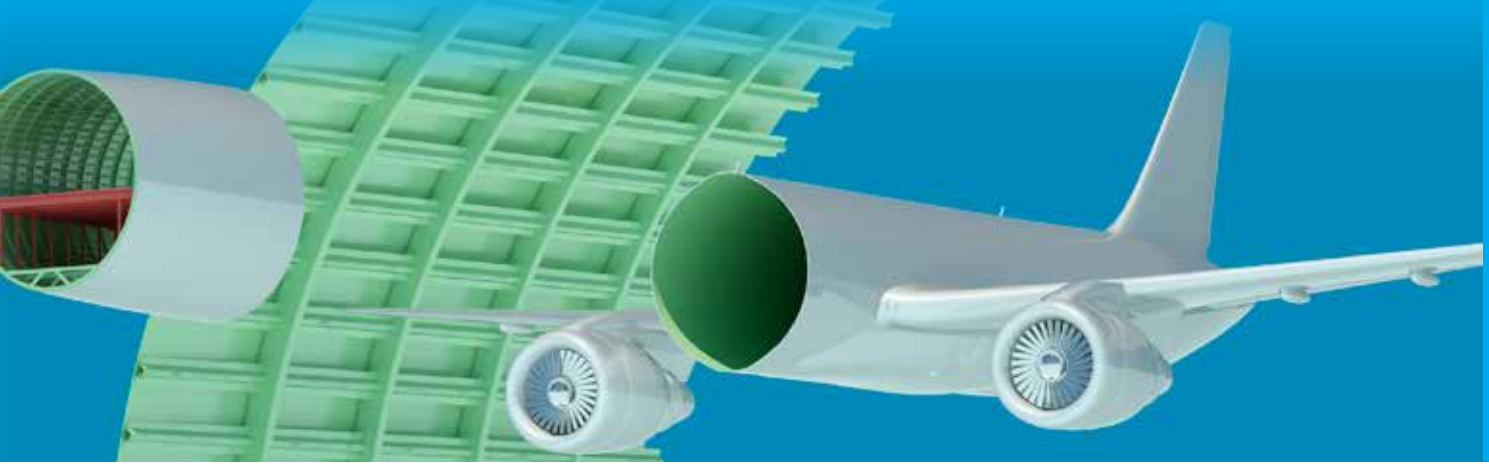
Composites

NLR has specialists and facilities with which it is possible to develop and produce high quality composites, all under one roof: from the first, conceptual design to testing prototypes and certification. By focusing on reducing weight and production costs, NLR specializes in developing affordable structures.

Flow simulation

The design of wings, engines and other aircraft components draws attention to small details. In many cases, it is a matter of experimenting until the best model has been found. This is why NLR develop computational models that simulate the interaction of airflow and planes and their effect on each other.
http://ecfd.nlr.nl





NLR and TU Delft jointly developed a new composite that is more resistant to impact and for which a patent was requested. With its fibre placement facility, NLR supports industry through the development of new innovative composite concepts. This facility is available to companies interested in conducting research projects focused on exploring the possibilities offered by fibre placement, on the fundamental or industrial level.

OBODAS

A new braiding technique renders the production of composites even more efficient. The production techniques for strong and light-weight composite materials are in full development, in the aviation sector and in other branches. In the OBODAS project, NLR worked in collaboration with the University of Twente and Eurocarbon in refining the 'braiding' technology, from which hollow component structures are produced. This project, named 'Innovating the over braiding design process to optimize the development of composite aircraft structural components' (OBODAS), focuses primarily on efficiency: NLR developed a simulation program that allows expensive test runs of the new braiding machine to be limited. Consequently, substantial costs reductions are achieved in the production of composites.

Fire FLY

In Fire-Fly, the fire department receives real-time, overview images of the area where a fire rages. This image is then sent to the crisis centre, police, other fire department units and fire fighters in the field, which allows the fire to be fought more effectively. Within this project, NLR is responsible for the warning system's technological operations, which includes system design, the processing of video images and the storing of data and images. The ultimate aim is for the various types of UASs (helicopters, quadcopters, octocopters, etc) to be capable of sending live images to the fire department's crisis management system, without requiring any intermediate steps.

External Fuel Panel

INDUSTRY: DEFENCE & SAFETY

NLR promotes the competitiveness of the Dutch aviation industry. NLR does this in partnership with the golden triangle of government, industry and knowledge institutes, thereby collectively increasing the innovation and sustainability capacities of the Netherlands.

NLR strives to be and remain a strategic partner for the Dutch aviation and defence industries. NLR, together with industry, focuses on competitiveness and sustainable productivity growth, and also on flexibility and affordability. We achieve this through collaborating in innovation. NLR and industry work together to inject knowledge in products intended for the market. In this, tests and evaluations conducted using modern facilities, such those available at NLR, are crucial.

Embedded Training for the JSF

With Embedded Training (ET), pilots of fighter aircraft can efficiently train for complex conflict scenarios. NLR and Dutch Space jointly developed for Lockheed-Martin an ET-system for the F-35 Lighting II, better known as the Joint Strike Fighter (JSF). This Embedded Combat Aircraft Training System (E-CATS) simulates flight training scenarios involving virtual enemies and other players. This ET system is a standard application in the JSF. In an earlier stage, ET was tested in Fighter 4-Ship (F4S), NLR's research simulator, in which tactical operations involving up to four fighter jets can be simulated. This validated the ET's practical applicability.

NLR has recently signed an intention with NATO Helicopter Industries (NHI), for the use of Embedded Training systems by NH90 helicopter crews.

Maintenance and logistics

NLR works on preparing the maintenance program for the JSF. Initially, certain tools were made for managing maintenance (Prognostic & Health Management). Together with industry and government, NLR is positioned for future maintenance and logistics in the European region.

Matching Tracks by Association and Correlation

Nose Wheel Steering System Controller

Remote Frequency Indicator

Cockpit Fuel Panel

"THE 'GOLDEN TRIANGLE' OF GOVERNMENT, INDUSTRY AND KNOWLEDGE INSTITUTES INCREASES INNOVATION IN THE NETHERLANDS"

Lightweight materials

The NLR works on lightweight materials, such as thermoplastic composites and Fibre Metal Laminates, which, because of their lower flight weight and wind resistance, lowers fuel consumption. NLR's research into structures based on lightweight materials also focuses on more affordable and environmentally friendly production methods for SMEs and industry. The development of production methods, such as Resin Transfer Moulding and Advanced Fibre Placement of thermosets and thermoplastics, are particular focal points of the research, testing and evaluation. The ability to detect damage, make repairs and gain insights into behaviour after repairs, are essential for use by industry.

Composite drag brace

Together with Fokker Landing Gear, NLR works on composite components for the JSF's landing gear. This drag brace is a rod that locks the landing gear, therefore ensuring that the landing gear remains in position during landing. Until now, these components were always made of aluminium or steel; however, a drag brace made of high quality composites (extremely strong and light synthetic fibres) is lighter, which allows the JSF to consume less fuel. The composites also require less maintenance.

Avionics for the NH90 helicopter

In collaboration with national and international partners, and SMEs, NLR is partly responsible for the design and development of avionics equipment for the NH90 helicopter. NLR supported e.g. Fokker Landing Gear with the design and development of the controller for the NH90 helicopter's nose wheel steering system. NLR designed and developed the controller and made prototypes. The qualification tests were largely conducted in NLR facilities. The controller is the intelligence of the nose wheel steering system installed on the Nato Frigate Helicopter (NFH), one of the two versions of the NH90. The current NFH-variant of the NH90 helicopter therefore flies using the NLR-designed controller for the nose wheel steering system.

"KNOWING WHAT DRIVES GOVERNMENT AND INDUSTRY, THIS IS WHAT DISTINGUISHES NLR"

GOVERNMENT: DEFENCE AND SAFETY

NLR is the most important Dutch knowledge supplier for both civilian and military aviation and aerospace. The objective is to develop high value aerospace technologies and thus strengthen the innovative and competitive capacities of the government and companies in the Netherlands.

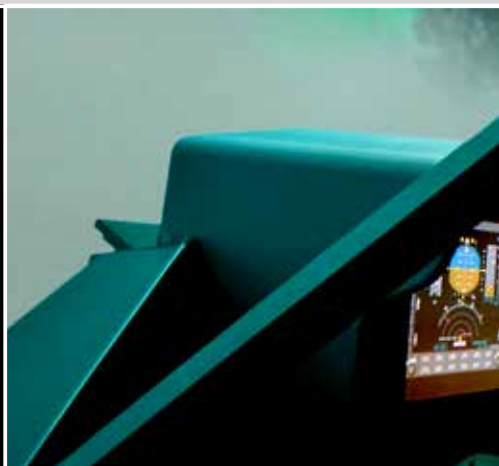
The Ministry of Defence and, in particular Air Force Command (Commando Luchtstrijdkrachten - CLSK) and the Ministry of Defence Material Organisation (Defensie Materieel Organisatie - DMO), largely rely on the NLR's technical aviation knowledge. CLSK and DMO make intensive use of support provided by NLR, for example during acquisitions and introductions, as well as in training, operational input in training and maintenance processes. As such, NLR has for 35 years successfully conducted SHOL-activities for the Ministry of Defence. SHOL stands for Ship Helicopter Operational Limits. This research determines the flight envelope under which helicopters can still safely land on frigates during extreme weather conditions.

Unmanned aircraft

NLR conducts multidimensional research on unmanned aircraft, for example with the support of MUAG (Mature Unmanned Aerial Ground Control Station). NLR uses this research simulator to study ground station concepts; for example, of concepts for UAV ground station personnel and the required training of these personnel. These concepts are a guide for how the Dutch military can deploy UAVs.

Brown Out

For the Ministry of Defence, NLR uses its HPS helicopter simulator to research helicopters in brown out conditions. Because dust clouds are often generated when helicopters land in sand, the pilot loses visibility during the last seconds of the landing. This can lead to unsafe situations. The Ministry of Defence therefore asked NLR to devise achievable solutions for the helicopters the Dutch military uses during tactical operations. The research involved the use of a Helmet Mounted Display (HMD). NLR developed a landing environment featuring dust cloud models and adjusted the HMD symbology.



NH-90 SDE

In the major Supportability Data Exchange (SDE) project for NH-90, NLR will develop and implement a large shared (via internet) NH90 user's database.

Nine European countries that operate NH90 helicopters will provide large amounts of information about their own (national) designs, usage, maintenance and damage.

With this information, it is possible to gain insight and give recommendations about, for example, the reduction of life-cycle costs, extending the helicopter's life span, maximizing operational deployability, and reviewing contractual flight performances. All of this is done while simultaneously securing the required flight safety levels.

Airworthiness, certification and qualification

The Ministry of Defence must be secure in the airworthiness of its aircraft. NLR uses certification and qualification processes to demonstrate that the airworthiness corresponds to current national military aviation regulations. Because NLR has the necessary insights into the effects of flight characteristics, flight performance and operational limitations, the safety and objectives of the operations can be guaranteed.

Replacement of F16

The Ministry of Defence purchases aviation-related weapon systems, such as, for example, a replacement for the F-16. These weapon systems are capital intensive and often deployed for many years, frequently under harsh conditions. In developing knowledge about the use, condition and threats posed to new weapons systems, NLR can provide independent advice to the Ministry. NLR supports the Ministry in the replacement of the F-16 in areas relating to, for example, airworthiness, operations, environment and training.

Energy generation

In future, fighter jets, like the F-16, will increasingly require electrical power supplies. It is not yet satisfactorily known how the generated internal energy is divided over the entire system, and what consequences this has for operational capacity, airworthiness, maintenance and lifespan. NLR uses calculation models to research what the influence of internal energy supply has on the operational deployability of military aircraft.

SPACE

NLR supports the strategic ambitions of industry and SMEs in the Netherlands as they strive to secure leading positions in the global market for upstream and downstream space products and services. Upstream space includes the technologies that allow satellites to function optimally in space, such as satellite cooling systems and the structures for launchers. Downstream space focuses on availability and use of satellite data for provision of services to a variety of users.

Space technology

NLR has comprehensive knowledge of space systems engineering, including mission analysis and attitude and orbit control of satellites. This expertise allows NLR to develop and test small satellite platforms. NLR has a 'Space System Simulation Laboratory' for developing, simulating and testing the space and ground segments. In addition, NLR has various engineering tools and test facilities required for supporting the development of space subsystems and components. Companies and institutions can make use of NLR's facilities.

NLR has specific expertise in thermal control on component and subsystem level, including the development of mechanically pumped cooling loops with flight heritage in space on-board the International Space Station. Another domain of expertise is data compression hardware and software for instruments aboard earth observation satellites. These avionics allow large amounts of data to be efficiently transported to Earth.

NLR develops and tests space structures, whereby the focus is on the use of lighter and stronger materials, such as composites, produced at lower costs. When designing space structures, ESA and industry use methods developed by NLR to predict the loads in space constructions and to establish the lifespans of such structures.

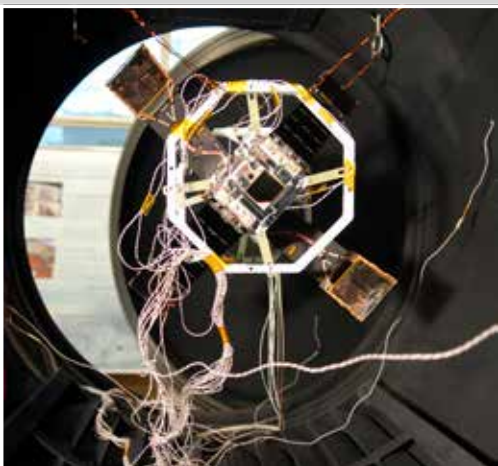
Space applications

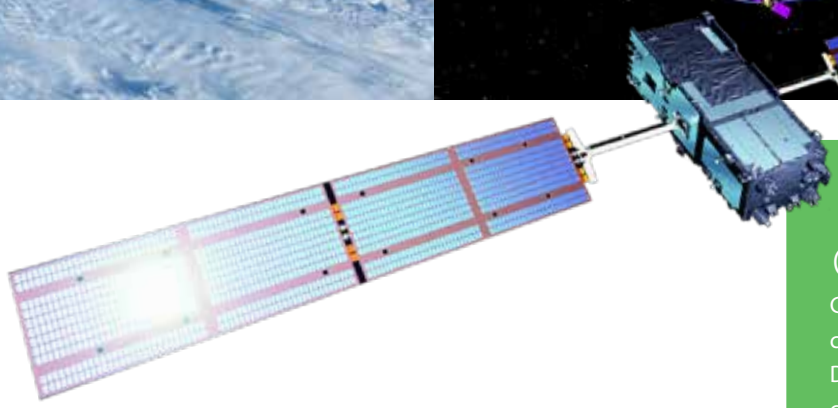
The 'downstream' market is growing rapidly due to the increasing guaranteed availability of satellite systems and the information that is made available via satellites. Applications concern telecommunications and earth observation, as well as satellite navigation.

Satellite navigation is based on Global Navigation Satellite Systems (GNSS), such as GPS, EGNOS (European Geostationary Navigation Overlay System) and Galileo. NLR has a wealth of experience in the testing and verification of satellite navigation systems. NLR is especially focused on the accuracy, reliability and security of applications. Moreover, NLR has a facility for monitoring the static and dynamic performance and analysis of satellite navigation systems.

There is growing interest in satellite data, including earth observation data among end-users in the space and defence sector, as well as numerous other areas, including railway transport, the energy sector, the agro-food sector, and various types of water management. A key accelerator of this use is the fact that the EU, as part of its open data policy, will make earth observation data from the Sentinel satellites available for free as of mid-2014.

NLR has the requisite tools and expertise for storing, processing, accessing and analysing earth observation data. NLR therefore offers added value to companies that develop applications and use the data generated by satellites.





Synergy of space and aviation

Satellites play an increasingly important role in the efficient and environmentally friendly operations of civil and military aircraft fleets. As shown by the projects carried out for the Galileo (see inset) and IRIS programs, NLR is involved in developing these types of satellite systems and the requisite technology. The ESA-initiated IRIS program focuses on supporting air traffic management (ATM) that is based on satellite communications.

In the area of surveillance, NLR develops and tests equipment for Automatic Dependent Surveillance Broadcast (ADS-B), which is a technology that allows aircraft to exchange information. Researchers are currently working on a system that enables ADS-B information to be collected and communicated by satellites.

Unmanned aircraft systems (UASs) in the airspace present new challenges. NLR has the space knowledge and ATM research facilities required, including flight simulators, test aircraft, and UAVs, for validating new concepts.

Galileo

Galileo is the European Union's civilian answer and a complementary satellite navigation system to GPS. During a test flight conducted in December 2013, NLR - as commissioned by ESA and Eurocontrol - was the first in the world to determine the flight position of an aircraft using the Galileo system's first four operational satellites. This test flight -using the NLR's Fairchild Metro-II research plane- proved that Galileo is capable of enabling accurate positioning under a variety of challenging, dynamic conditions. It is expected that in the coming years Galileo will enable such applications in many areas.

Unique cooling system

NLR has broad knowledge and experience of heat transport systems. NLR has consequently developed the Tracker Thermal Control System, a unique space-worthy cooling system for the Alpha Magnetic Spectrometer instrument (AMS-02), which is a particle physics experiment module that has been operational aboard the International Space Station (ISS) since 2011.

Geomatics Business Park

NLR's initiative led to the creation of the Geomatics Business Park (GBP), where small and medium sized enterprises in collaboration with NLR experts develop applications using earth observation data.

www.geomaticspark.com

FACILITIES

NLR has a wide selection of specialized research facilities, ranging from simulators to wind tunnels. With these facilities, backed by our knowledge and expertise, we can meet the needs of our stakeholders, while strengthening the innovativeness, competitiveness and effectiveness of the government and industry.

Flight and mission simulators

The NLR's flight simulators imitate a wide variety of aircraft. This allows us to study how pilots deal with new systems and flight procedures. These research simulators are unique worldwide, owing to their well-devised modular structure. All software for the simulators is developed in-house at the NLR, which allows us to quickly adapt a simulation to new requirements.

NLR operates two flight simulators: GRACE and APERO. For mission simulations, NLR has the GFORCE, Fighter4Ship (F4S), Helicopter Pilot Station (HPS), Unmanned Aerial Vehicle (UAV) and Helmet Mounted Display (HMD).

Research aircraft

NLR operates two research aircraft, for testing new techniques and procedures. Both aircraft are extremely suitable for testing new sensors. Recent examples are data link tests between VHF radio and satellite. Flight tests have also been carried out to test new procedures for the approach to airports. On-board measurement equipment precisely records how operators are handling the controls, thus providing a good indication of the human factor in flight operations.

Air traffic control simulators

NLR combines operational knowledge about air traffic control management with fast-time and real-time simulators for the development of concepts, systems and procedures to increase the capacity of the ATM system, to maintain safety in the air, and to have the least possible impact on the environment. For this NLR uses two simulators, in which research is focused on the various aspects of air traffic control: NARSIM Radar – an air traffic control centre or radar simulator, and NARSIM Tower, an air traffic control tower simulator, in which, for example, new equipment is tested for earlier detection of potential conflict situations.

Composites lab

NLR possess all the means necessary for developing new materials: a well-equipped laboratory, design and calculation programs and access to the expertise and facilities of other NLR departments. The NLR has a fully automated Resin Transfer Moulding machine (resin injections), used for the preparation and injection of composite parts, and a Fibre Placement Machine, suitable for thermosets, thermoplastics and dry fibre reinforcements. We conduct non-destructive research, process monitoring and control, thermal analysis, permeability measurements and material properties.

"OUR EXPERTISE AND STATE OF THE ART FACILITIES INCREASE INNOVATIVENESS, COMPETITIVENESS AND EFFECTIVENESS"

Ultramodern facilities

- Aerospace and geo-information
- Electro-magnetic magnitudes lab
- Area tests
- Computational Fluid Dynamics
- eCFD (flow simulation)
- Precision engineering equipment
- Optical, noise and vibration tests
- Testing site for lifespan of aircraft components
- Testing of constructions (e.g. Test hall)

Wind tunnels

NLR possesses various wind tunnels, where the airworthiness properties of aircraft and helicopters are measured. Or cars, trucks or bridges are streamlined. And it is not only about aerodynamic properties: NLR for example also conducts noise measurements, fail tests and measures ground effects during landings. The wind tunnels are operated by German-Dutch Wind Tunnels DNW, a joint venture with the German partner institute DLR. Via this joint venture; NLR also has access to a number of wind tunnels in Germany. NLR possesses the Large Low-speed tunnel (LLF), Low-speed tunnel (LST), the High-speed tunnel (HST) and the Supersonic Tunnel (SST).

"WITH OUR CAPABILITIES, WE SATISFY THE NEEDS OF THE AVIATION AND AEROSPACE SECTOR"

FACTS AND FIGURES

Turnover in 2013 in euro's:	72 million
Contracts	54 million (75%)
Demand-driven programs	18 million (25%)

Breakdown across sectors	
Industry	29 million (41%)
Civil Aviation	14 million (18%)
Defence-Government	25 million (35%)
Space Technology	4 million (6%)

What is NLR?

- Almost 650 people work at NLR
- NLR possesses wind tunnels, simulators... and research aircraft
- NLR has a turnover of approximately 72 million euro's.

More information?

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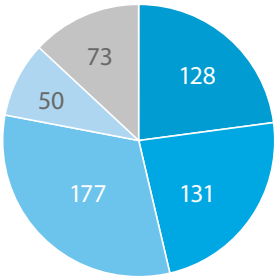

Number of staff per division
Full-time equivalents (excluding DNW)

- Aerospace Systems
- Air Transport
- Aerospce Vehicles
- Support Staff
- Support Services

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