Space for Innovation

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

Space Technology
Space Applications

Introduction

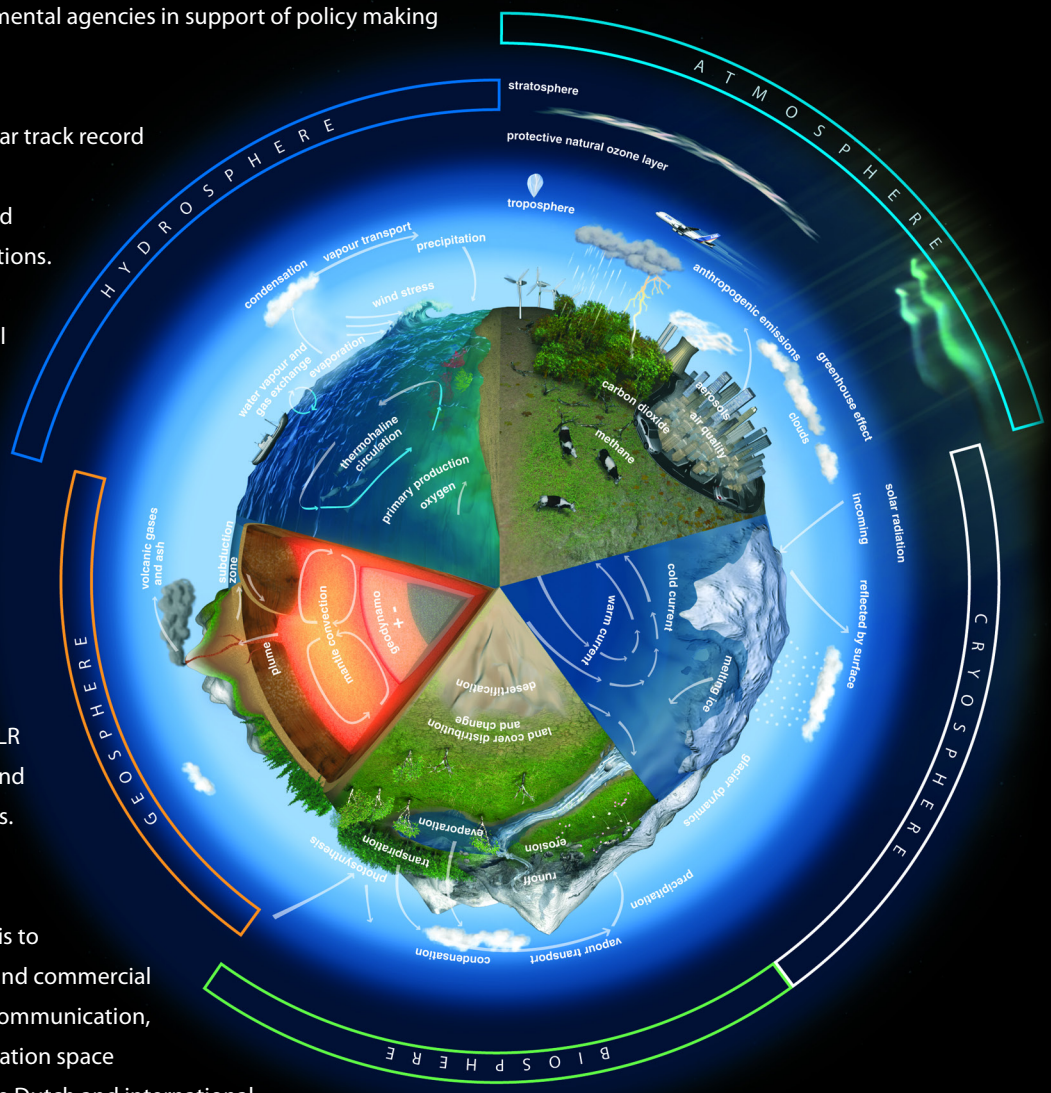
After more than 50 years of satellites in operation, space has become a normal part of our daily life. Space infrastructure has become an indispensible asset for world economy, for environment, safety and security applications and provides an essential enabler for science.

New challenges are ahead, as formulated in the "European White Paper on Space" , to exploit space technologies in support of the Union's policies and objectives: faster economic growth, job creation and industrial competitiveness, enlargement and cohesion, sustainable development, and security and defence. Europe aims to ensure that citizens will have access to all benefits from space in their everyday life. All this requires strong development in space technology to meet future needs for space infrastructure as well as for space applications.

The role of the National Aerospace Laboratory (NLR) in space projects is linked to these European ambitions, in line with Dutch government policies for industry, transport, security, environment and defence. The NLR plays a role in the development, testing and adoption of technology innovation, as well as in spin-offs of space technologies in other domains. The NLR also makes available its knowledge and expertise to governmental agencies in support of policy making

Current NLR R&D Topics

The NLR has built up an almost 50 year track record in both the development of space infrastructure-related technology and in the development of space applications. The NLR works in these domains in European (ESA, EDA, EC) and national projects (Netherlands Space Office, Ministry of Defence).



Space Technology

The objective for space technology development is to increase the technology readiness level to support industry in improving its competitive power and position. In the space technology domain, the NLR works with national space industry and the large European prime contractors.

Space Applications

The objective for space applications is to stimulate and promote operational and commercial use based on information from telecommunication, earth observation and satellite navigation space infrastructure. The target group is the Dutch and international user community and the companies developing and providing value adding applications and services. Space applications in the defence and aviation domain are of prime importance to the NLR. These applications include the use of space systems enabling integration of unmanned aerial vehicles in segregated and non-segregated airspace, as well as communication / surveillance / navigation of aircraft in airspace. This activity includes development and provision of pre-operational and operational facilities.

Systems Engineering

The NLR has broad knowledge and extensive experience in Space Systems Engineering. The NLR Systems Engineering capabilities include mission analysis, attitude and orbit control, electric and cold gas propulsion, and station keeping. These capabilities are being applied in the development of satellite systems such as the Dutch scientific satellite Sloshsat FLEVO, and small satellite platforms and systems currently under development. The NLR activities in the area of test and simulation aim at supporting the complete life cycle of space systems, ranging from initial simulations, through system and sub/system testing and verification, up to operations support.Testing allows combined use of simulated and hardware units. The interaction with the hardware of the system-under-test includes reliable and accurate electronic and data interfaces. The testing process is supported by a semi-automated test environment.

The NLR uses commercial and in-house developed tools for Space Systems Engineering (System Architect, STK™ and Matlab/Simulink™), for simulation and test (Eurosim™), requirements management (Doors™) and automated simulation model transfer (MOSAIC).

Thermal Systems

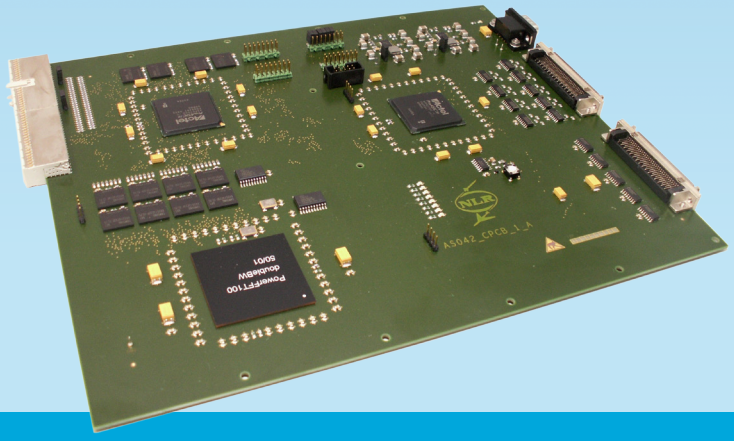
The NLR conducts research, development and test of thermal control systems. Historically, the NLR has extensive knowledge on capillary pumped cooling systems such as Heat Pipes and Loop Heat Pipes and vast experience in space thermal system design. New developments focus on pumped cooling systems for space applications, micro-scale pumped cooling devices and the development of new thermal concepts such as high conductive carbon fibres, carbon foams, and Oscillating Heat Pipes. The extensive experience leads to spin-offs in airborne and industrial applications, including cooling of avionic systems and airborne radars.

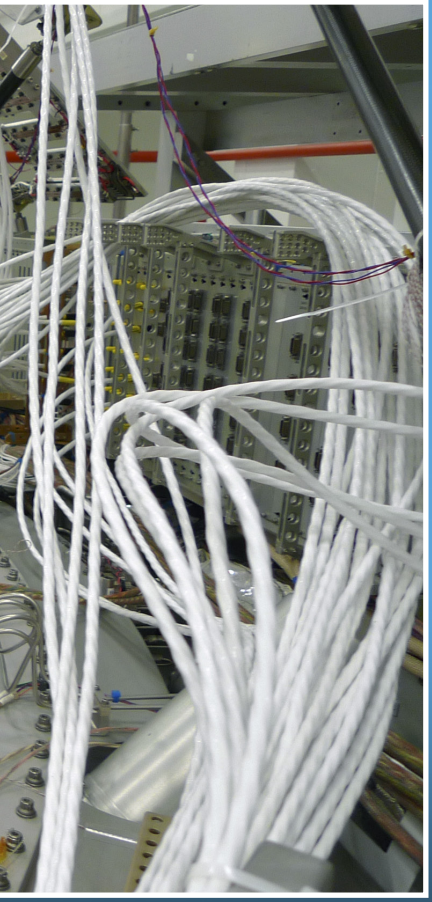
Facilities for Production and Testing of Space Sub-Systems

Space electronics must be produced under well controlled conditions. To do so, the NLR operates clean room facilities and has ESA-qualified solder equipment, including tools for SMD assembly. The NLR employees for assembly, modification and inspection are ESA-qualified. Extreme conditions for survival and operation of space electronics can be tested at the NLR facilities for space electronics. As part of the NLR facilities for environmental testing, the NLR operates a space vacuum simulator, a climate chamber and a clean room facility to handle flight equipment. The facilities support the NLR R&D activities but—more importantly—give easy access to Dutch industry for development and qualification testing of new space subsystems and components.

Space Qualified Avionics

The NLR has extended experience in design, production and testing of space electronics, which is subject to stringent demands on processes and procedures specific for space applications. Examples of space electronics projects range from very small (miniaturised) to large multiple board assemblies for scientific and operational applications, such as Cells-In-Space, Sloshsat Data Handling Subsystem and SAR data compression for Sentinel missions. The NLR develops scalable hardware and software systems for On-board Payload Data Processing (OPDP), primarily for earth observation missions. OPDP includes hardware for the compression of radar data, intelligent on-board software for cloud avoidance scheduling, dynamic region-of-interest selection and SAR processing functions. This technology becomes increasingly important due to ever growing data rates produced by state-of-the-art airborne and spaceborne sensors and limitations on data link bandwidths.



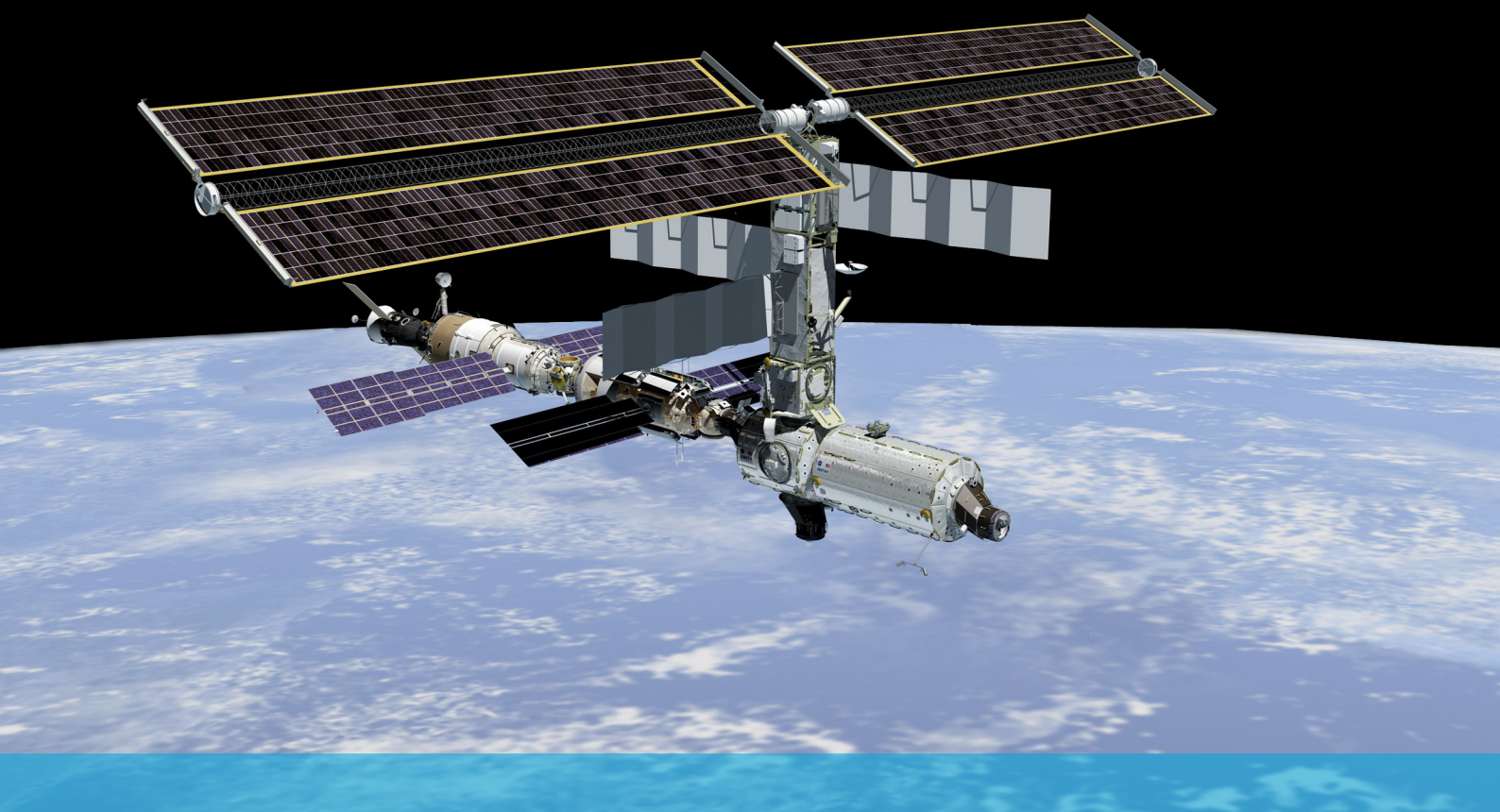


Launchers Structures and Modelling

The NLR conducts research, development and testing in the area of space structures and modelling, with focus on the use of lighter and stronger materials that can be produced at lower cost. The NLR has extensive knowledge and facilities regarding these activities for design methods and analysis, loads calculation, aerodynamics, full scale component testing, materials qualification, fabrication technology and wind tunnel models and testing. Especially in the field of composites, the NLR has the capability to support industries in their development of light weight affordable structural components. The NLR has a well equipped composites facility in which components up to the level of full scale prototypes can be manufactured. In support of the technology development, the NLR has test facilities that can conduct full scale certification tests on structural elements in a wide variety of environmental conditions..

Space Utilisation

The NLR activities in the field of space utilisation focus on development and integration of ground support systems and on support to operations in space, especially the operations of the ISS. The NLR is the Dutch representative for supporting space experiment operations, and is directly involved in the implementation and operation of the Erasmus User Support and Operations Centre (USOC) at ESTEC, Noordwijk.
The Erasmus USOC is responsible for operations on the Columbus European Drawer Rack, which host scientific and technological experiments. The Erasmus USOC is one of the main European Columbus Facility Responsible Centres, and is therefore an important element of the European space infrastructure. NLR has developed the Mission Preparation and Training Equipment for the European Robotic Arm (ERA), which will be operating on the outside of the Russian segment of the International Space Station. Tele-operation concepts have been developed for ESA to support remote operations of facilities and experiments on-board the ISS. These technologies will be elaborated and tailored to be used in future space/exploration missions like mission planning, operator training and tele-operations / tele-science for missions to the Moon and Mars.



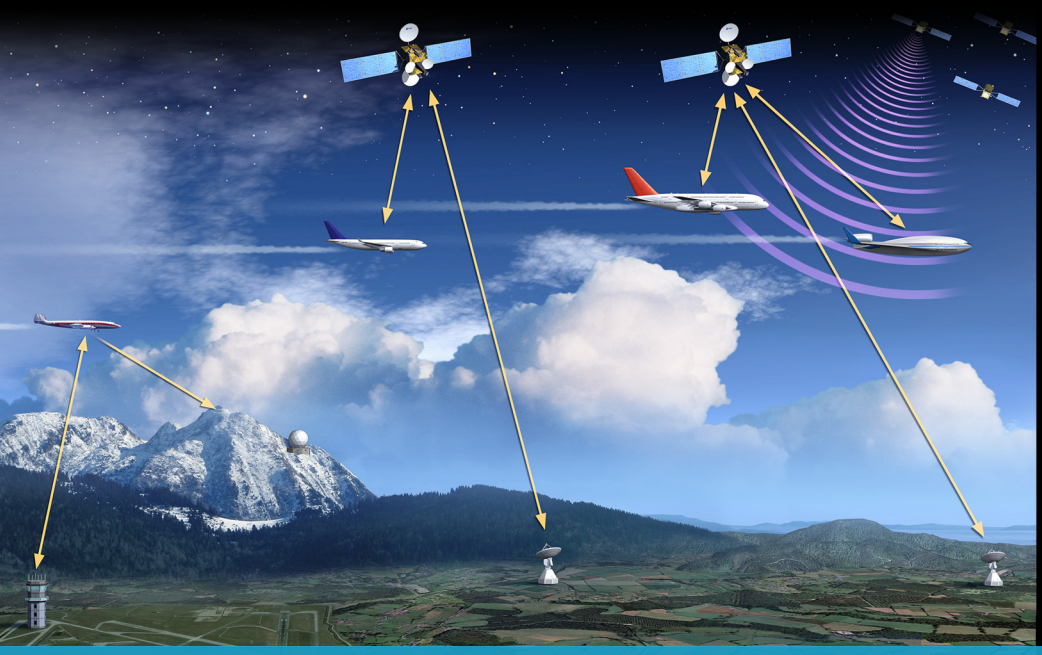
Satellite Navigation

Global Navigation Satellite Systems (GNSS) are becoming an increasingly critical part of the public infrastructure. The operational GPS system provides a global user community with positioning and timing information. Regional augmentation systems such as the European Geostationary Navigation Overlay System (EGNOS) provide the GPS user with additional reliability and accuracy. The future Galileo satellite navigation system features further improvements over the current GPS system, most notably Galileo's guaranteed integrity, availability and accuracy services. These improvements facilitate the use of Galileo for mission critical and safety-of-life applications such as tracking-and-tracing of hazardous goods, road pricing, navigation for the aviation sector, and precise timing applications. The qualification and certification of products and services that make use of satellite navigation data is of prime importance. This also applies to the qualification and certification of the satellite navigation infrastructure on which these products and services are built.

The NLR aims to be a centre of GNSS expertise with a clear understanding of the possibilities and limitations of the systems and the services they provide. Based on our extensive aeronautical track record, the NLR focus is on mission-critical and safety-of-life applications. As a contributor to the development of both EGNOS and Galileo, and by operating our own GNSS monitoring facilities, the NLR is well positioned to support industry in the development and qualification of new GNSS-based products and services, and to support the public sector in setting up policies and a regulatory framework in which both end-users and service providers can find maximum benefit from the available satellite navigation signals.

Communications, Navigation and Surveillance for airspace

Space will play a more and more important role in handling the dense traffic in European air space. To increase the efficiency in Air Traffic Management (ATM) more automation is needed. Voice communication will be largely replaced by data link communication. Also the introduction of Unmanned Aerials Vehicles in the airspace leads to new challenges where space infrastructure will play an important role. The NLR has the knowledge and facilities to validate new concepts in the real world. The combination of NLR's space knowledge with the ATM research facilities offers a unique capability for our customers.



Earth Observation

The EC 'Global Monitoring for Environment and Security' (GMES) programme represents a concerted effort to bring data and information providers together with users, so they can better understand each other and make environmental and security-related information available to the people who need it. The NLR contributes to this programme by researching and developing image processing and analysis algorithms in order to provide valuable geospatial information for a variety of applications. Applications of earth observation include mobility, environment, defence and security.

Information derived from earth observation has become an operational element in support of activities carried out by government agencies and industry. Supporting services to industry and governments are offered on a commercial basis by the so-called value adding industry. Together with these industries, the NLR researches and develops tools for efficient integration of earth observation data within these services.

Geospatial Data Service Centre

The NLR initiated the Geomatics Business Park (GBP), a co-location of several Small and Medium-sized Enterprises (SMEs) in the field of geomatics, in particular earth observation. The GBP reflects the need for a more demand-driven service oriented space industry, in addition to the more supply-driven equipment (platforms and sensors) industry. To support the value adding industry and government agencies in their need for management and interoperability of their geospatial data sets and services, NLR is developing a Geospatial Data Service Centre (GDSC), based on open standards for geospatial data and in line with European Union INSPIRE guidelines. An element of this GDSC is a 4-dimensional geospatial data infrastructure (4D-GSDI) in which multiple geospatial data sets can be accessed, visualised, analysed and results stored and disseminated.

Technology Dual Use

The NLR stimulates the dual use of technology. One of the knowledge areas focuses on the application of complex antenna technology in aircraft and spacecraft for communications, navigation, and remote sensing. In the area of satellite communications, research is carried out with respect to phased array antenna technology. The major challenges are:

- to achieve low-cost beam forming conformal antennas that are able to dynamically steer the antenna beam and to track the moving satellites while maintaining broadband communications
- to develop technology to compensate for the adverse effects of vibration and deformation of large antennas.

Another knowledge area focuses on Integrated Modular Avionics (IMA) in which standardised space avionics computers provide processing capabilities and communication to various third party applications, including software applications. The NLR supports translation of concepts to space applications in order to benefit from civil and military field proven technology.

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WHAT IS NLR?

- The National Aerospace Laboratory (NLR) is the key center of expertise for aerospace technology in the Netherlands;
- NLR employs around 700 people, including 300 with a Master's degree and about 150 with a Bachelor's degree;
- NLR's facilities include wind tunnels (for testing aircraft produced by Airbus, Lockheed Martin and others), simulators (for testing the safety of new flight procedures, among other things), and laboratory aircraft;
- NLR's revenue adds up to €78 million, with contracts accounting for €56 million (2009);
- 75% of our contract work is directly or indirectly government-funded

Information

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