



**Łukasiewicz**  
Institute  
of Aviation

**RESEARCH & SERVICES  
FOR INDUSTRY**





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## CONTACT

# GENERAL COMPANY INFORMATION

Łukasiewicz Research Network - Institute of Aviation is one of the most modern research institutions in Europe, with traditions dating back to 1926. The Institute closely cooperates with the world's tycoons of the aviation industry and institutions from the space industry. The strategic research areas of the Institute are aviation, space and unmanned technologies. Tests and services for domestic and foreign industry in the field of metallic and composite materials, additive, remote sensing, energy and mining technologies are also carried out here. Łukasiewicz Research Network - Institute of Aviation is made up of eight research centers:

## AVIATION TECHNOLOGIES CENTER

develops technologies dedicated to aircraft design, aerodynamic research and aircraft certification.

## SPACE TECHNOLOGIES CENTER

conducts research and development in the field of space propulsion, space transportation, satellite testing and remote sensing.

## UNMANNED AERIAL VEHICLE TECHNOLOGIES CENTER

conducts research and development in the field of drones and anti-drone systems.

## MATERIALS AND STRUCTURES RESEARCH CENTER

offers materials and structural components testing in a wide range of loads and temperatures. Thanks to a large number of certified test stands it is a regional leader in fatigue and strength testing.

## COMPOSITE TECHNOLOGIES CENTER

delivers composite technology solutions and composite material tests for the aerospace industry.

## ENGINEERING DESIGN CENTER

is an engineering alliance between General Electric Company Polska Sp. z o.o. and Łukasiewicz Research Network – Institute of Aviation. The Center offers design, research and development services in the fields of aviation, gas power and renewable energy.

## ENGINEERING SERVICES CENTER

provides engineering support in the field of analysis and design to strategic research and development projects.

## ENERGY TECHNOLOGIES CENTER

focuses on engineering areas: designing, manufacturing, analyzing and servicing parts for high-power gas turbines and wind turbines. One of the main tasks of this center is to implement a new energy era that will build a cleaner future.

# OFFER

The research centers established at the Institute carry out work for domestic and foreign heavy industry and related sectors.

Łukasiewicz Research Network - Institute of Aviation offers a wide range of research and engineering services that go far beyond its core business areas, which include the following technologies\*:

- Aviation.
- Space.
- Unmanned.

The Institute, in addition to research and development in the field of aeronautics and aerospace, conducts work for the following sectors:

- Energy.
- Oil and gas.
- Automotive.
- Railway.
- Construction.
- Agricultural.
- Armaments.
- Sports.
- Other.

Our offer of research and engineering services for industry and related industries includes the following disciplines and specialties:

- Non-aviation aerodynamics.
- Automation.
- Electronics and electrotechnics.
- Photogrammetry and remote sensing.
- Chemical, process and materials engineering.
- Mechanics.
- Robotics.
- Reliability analysis and analytical tools and predictive algorithms.
- Software development.

*\*A detailed offer in the field of aviation, unmanned and space technologies (and related research in the area of composites and materials technologies) is available in the separate offer folders.*

# ŁUKASIEWICZ FOR BUSINESS

The Institute is part of the Łukasiewicz Research Network, bringing together over 30 research institutes from all over Poland to provide attractive, complete and competitive technological solutions.

## THE CHALLENGES

Łukasiewicz offers for business a unique system under which a group of 4,500 scientists in no more than 15 working days accepts the challenge and proposes to the entrepreneur an effective implementation solution. At the same time, it involves the most qualified Polish scientists and unique scientific equipment. Most importantly - the entrepreneur does not bear any costs related to the development of the research concept.

The entrepreneur may decide to contact us not only via the form on the website:

<https://lukasiewicz.gov.pl/biznes/>, but also in over 50 locations: Łukasiewicz institutes and their branches throughout Poland. Entrepreneurs will receive the same high-quality product or service everywhere.

## ŁUKASIEWICZ RESEARCH GROUPS

Łukasiewicz's potential focuses on such research areas as:

- Health.
- Smart and clean mobility.
- Digital transformation.
- Sustainable economy and energy.

Łukasiewicz Research Network – Institute of Aviation operates within the Intelligent Mobility Group (12 institutes involved) focusing on technologies related to the design, manufacturing, production, characterization and use of logistic infrastructure and vehicles.

The group conducts research and development work in the field of electromobility and environmentally friendly structural solutions in means of transport, materials with extended functionality, robotics and control systems, as well as machines used in agriculture, aviation and space technologies.

Our innovation in the field of technologies for energy storage, processing and recovery technologies, including research on hydrogen cells, fuel cells, supercapacitors and batteries is also an important aspect.

Innovation in smart mobility also includes the design of transport, logistics and supply chain management systems, as well as modern warehousing and effective distribution networks.

The group's activity is also focused on the development of methods for diagnostics, monitoring and optimization of processes, sensor networks and standardization.

For more information about Łukasiewicz, please visit: [lukasiewicz.gov.pl](https://lukasiewicz.gov.pl).





# RESEARCH & DEVELOPMENT

Łukasiewicz Research Network – Institute of Aviation conducts research activities focused on practical application work results. The main area of scientific interest are issues related to the development of aeronautics and cosmonautics. An important aspect of activity are also research, services and implementations for industry from other areas.

Applied research and implementation activities are carried out in-house or in cooperation with institutes of Łukasiewicz Research Network or other domestic and foreign scientific and production centers through joint projects and orders for research services.

## LABORATORY BASE

Laboratory infrastructure of Łukasiewicz Research Network - Institute of Aviation is located in Warsaw, next to Fryderyk Chopin Airport at Okęcie.

The Institute runs nearly 30 specialized laboratories and workshops, including the largest wind tunnel in Central and Eastern Europe and the Gas Turbine Center with the Europe's largest vacuum chamber.

Thanks to such an extensive infrastructure with a wide range of services provided, engineering teams can not only get engaged and independently implement global projects from a wide range of heavy industry sectors, but also have the opportunity to gain the necessary professional experience and improve and develop Polish engineering thought.

Research and development services are performed in laboratories accredited by the Polish Accreditation Center.







# ENERGY SECTOR

The Institute is working on the development of the most modern solutions for gas energy needs. High and low power turbines are designed or developed here, as well as electric motors or power generators.

## GAS TURBINE CENTER

The Gas Turbine Center is a modern research and design center specializing in design and repairs of all types of gas turbine components used in power engineering.

GTC specialists create new turbine designs from the conceptual level, as well as develop and improve the already existing fleet, taking over responsibility for an increasing number of components.

Gas Turbine Center consists of:

- Assembly Hall equipped, among others, with a gas turbine simulator intended for training mainly related to assembly and disassembly of elements.
- Repair Hall with process rooms.
- Engineering design and service offices.
- Innovation Workshop for building 3D models to test new ideas.
- Vacuum Chamber for testing fans and rotating parts of aircraft engines and industrial turbines.
- The ability to test gas turbines over a wide spectrum, i.e. from 0.5 MW to 250 MW, innovative spaces, state-of-the-art instrumentation, and direct access to experienced and qualified automation specialists, programmers, designers and technicians make the Center a unique place of its kind on the technological map of Europe.

## MATERIALS SCIENCE LABORATORY

Materials Science Laboratory is one of the best equipped research institutions in Poland and in the European Union in the area of failure analysis.

The main tasks of the laboratory are material and failure analysis of components for commercial engines, gas turbines, steam turbines, compressors, reciprocating engines and wind turbines. The laboratory supports analyses in the fields of aviation, oil and gas processing, energy and related areas.

The laboratory is accredited according to the PN-EN ISO/IEC 17025:2018-02 standard for selected testing methods: hardness measurement, coating thickness measurement, non-destructive testing (penetration).

## LABORATORY FOR HEAT TRANSFER AND FLUID MECHANICS

It is the only place in Poland and one of the few in Europe, which, using modern measurement methods conducts comprehensive research work aimed at development of technologies related to cooling components of both aviation and industrial turbine engines. The modern control and measurement base includes two measuring stands able to work in manual and fully automatic control mode which is unique on a national scale. The base offers the possibility of multi-stream supply to the measuring stands. High-class laboratory equipment allows the engineers to perform precise measurements of numerous parameters, in particular temperature, humidity, pressure, flow, velocity and three-dimensional turbulence levels. Research is carried out in areas such as film cooling and impingement cooling.

Recently, technologies have also been developed on infrared recording of the temperature of internal components of a high-pressure turbine. Knowledge of the technology and possession of the so-called know-how used to design an IR test stand is available only in a few of the most developed countries in the world. The laboratory actively establishes contacts and cooperates with other units both at the national and international level, e.g. with laboratories from Italy, Germany, or the United States.

## AERODYNAMIC RESEARCH LABORATORY

The laboratory offers tests in the area of energy and its resources, including aerodynamic evaluation of wind turbines and aerodynamic testing of models of power units and cooling towers. The laboratory is equipped with two low-speed tunnels (T-1 and T-3) as well as a low-turbulence tunnel (TMT) suitable for conducting research in the area of power industry.

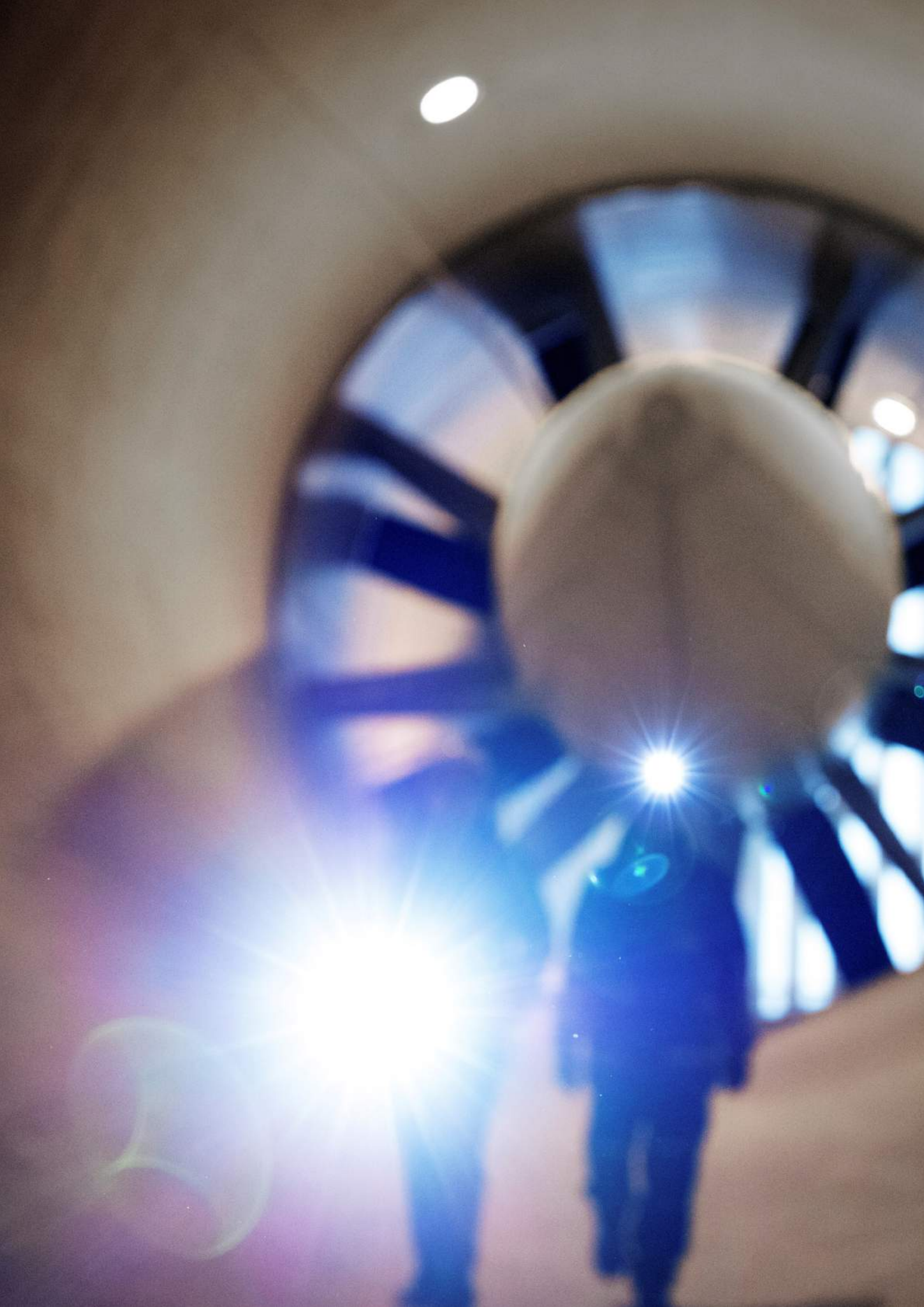
The Laboratory has implemented:

- Quality Management System compliant with the requirements of PN-EN ISO 9001:2015,
- Laboratory Management System compliant with the requirements of PN-EN ISO/IEC 17025:2018-02,
- Internal Control System Criteria.

The technical test results obtained in the laboratory are recognized by both the International Standard Organization ISO and by the International Laboratory Accreditation Cooperation ILAC. Since 22nd October 1997, the Laboratory has held the Accreditation Certificate No, AB 129 granted by the Polish Center of Accreditation.

## COMPUTATIONAL AERODYNAMICS DIVISION

The unit is a leading center in Poland conducting design work and analysis using computational methods and techniques (CFD). The laboratory employs high-class specialists in numerical aerodynamics, structural design and optimization. The laboratory has experience in designing innovative solutions in the area of wind power industry, confirmed by patent protection.





# OIL & GAS INDUSTRY

The Institute includes the laboratory providing services to the oil and gas industry. It is the only such place in Warsaw and one of the few in Poland.

## TEST LABORATORY

The Test Laboratory is one of three such facilities in the world and is the second largest in size. The main tasks are pressure and temperature testing of plant equipment for oil and gas extraction, especially for offshore solutions sectors, support for launched product lines, participation in the introduction of new products and sales support. Numerous components of the equipment used for oil and gas extraction can be tested, e.g.: valves, gaskets, large-size coupling clamps to connect pipeline sections, a number of system components for extraction platforms working both onshore and offshore. The laboratory is also ready to meet the requirements of other businesses by creating the appropriate conditions for performing the tests, e.g. a quick gas decompression or specific flows of various media (oil, hydraulic fluids, etc.).

The Test Laboratory has the Accreditation Certificate granted by the Polish Center of Accreditation, which confirms compliance with the standards PN-EN ISO / IEC 17025: 2018-02.



ESCLUSI STRADALI DEL MONTE

1. Cantieri aperti - in attesa
2. Area lavori programmati
3. Tagliando
4. Finito - aperto per traffico

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2.15  
109  
18  
3  
77

# MANUFACTURING INDUSTRY

Łukasiewicz Research Network - Institute of Aviation employs advanced technologies for optimization and automation of production. Customers can also take advantage of a wide range of additive manufacturing.

## ADDITIVE TECHNOLOGIES

Investment in laboratory research and production equipment helped to create in Łukasiewicz Research Network – Institute of Aviation a modern and comprehensive center of additive manufacturing and CNC. Although the Institute specializes in 3D printing mainly for aviation, unmanned aerial and space industries, its offer is also oriented on other industries.

## DEPARTMENT OF MODERN MANUFACTURING TECHNOLOGIES

The department focuses mainly on technologies of selective laser melting of metal powders and superalloys. Scientific research is carried out within the framework of subsidy schemes, research projects, doctoral studies, and partly also in the form of consulting services.

The engineering team of the Department performs the following tasks:

- Development of design requirements.
- Provision of process limits.
- Selection of manufacturing technology / material / printing parameters.
- Development of technological bases and machining surplus.
- Preparation of CAD model.
- Preparation of model for printing (orientation, 3DP support).
- Iterative development of special laser parameters.
- Developing method of powder evacuation from printouts (metal printing).
- Development of support removal method.
- Heat treatment.
- Selection and preparation of tools for CNC machining / wire cutting.
- Iterative development of machining parameters.
- Iterative development of finishing parameters.
- Verification of manufacturing tolerances and print quality.
- Verification of machining and finishing tolerances.
- Verification of tightness and patency of measurement channels.

## LABORATORY OF ADDITIVE TECHNOLOGY DEVELOPMENT

The laboratory specializes mainly in DMLM (Direct Metal Laser Melting). DMLM is a technology of additive manufacturing of three-dimensional metal objects. To obtain them, a laser is used to melt ultra-thin layers of powdered metal. Using a laser to selectively melt thin layers of tiny particles produces objects with fine, dense and homogeneous properties.

The most common materials used in this technology are: alloys of titanium and aluminum; stainless, surgical and tool steels; nickel superalloys such as In718 and cobalt and chromium superalloys.





The laboratory is equipped with the latest DMLM printer manufactured by Concept Laser from GE Additive group - M2 Cusing Multilaser. It is the second generation of the well-known version of M2 Classic with a workspace of 250 x 250 x 350 mm and laser power of up to 2 x 400 W.

The machine has several measurement systems for continuous monitoring of product quality, repeatability and safety of the printing process.

The high-end equipment enables engineers to carry out continuous research projects related to additive technology and produce real prototypes of aircraft engines.

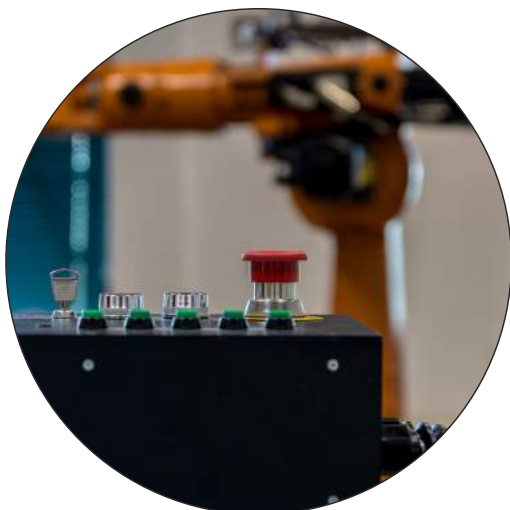
### INDUSTRIAL AUTOMATION AND MEASUREMENT SYSTEMS

The vast experience gained during the development of infrastructure of Łukasiewicz Research Network - Institute of Aviation and in the course of implementation of a wide range of projects for external customers allows us to provide comprehensive services in design and introduction of modern solutions in the area of industrial automation and measurement systems.

### LABORATORY DEVELOPMENT AND MAINTENANCE TEAM

The team focuses its activities on the design and implementation of widely understood measurement and control solutions. The main branches of its activity include design, implementation and start-up of: Control and Measurement Instruments and Automation systems; safety systems; industrial systems of PAC controllers; HMI and SCADA interfaces and complete measurement systems for the needs of laboratories.

- The team is experienced in working in interdisciplinary groups (engineers, constructors-mechanics, automation specialists, electricians, construction subcontractors, installation teams).
- It supports test implementation in instrumentation and measurement data analysis.
- It provides measurement services for research, scientific and engineering applications using high-speed cameras (Phantom v1612 cameras recording high-resolution images at ultra-high frame rates).
- It provides full support in conducting tests and interpretation of the results.







# AGRICULTURE

The main activities carried out in the Łukasiewicz Research Network - Institute of Aviation in the area of work for the agricultural industry and related fields are: creation of vegetation indices and vegetation testing, water testing, conducting research projects for modern agriculture, and the use of remote sensing in forestry works in soil science and for monitoring the effects of pollution.

## REMOTE SENSING

Qualified employees of the Łukasiewicz Research Network - Institute of Aviation have competence and expertise in areas such as: electronics, mechatronics, geoinformatics, aviation, physics, photogrammetry, biology, geology, geography, and information technologies. They deal with widely understood data acquisition and processing with the use of various types of sensors, including those mounted on board of manned and unmanned aerial systems.

Their activities are mainly focused on:

- Development and integration of optoelectronic systems.
- Development of control systems and UAS designs.
- Electronic and mechanical systems for UAS.
- Integration of on-board avionics.
- Integration with airspace traffic management systems.
- Operational acquisition of images and aerial data.

The tasks performed include: electromagnetic radiation recording devices in the optical range (reflected from the tested object), LiDAR sensors and radars.

We perform calibrations, tests and integration of sensors, tests in the field of automation and robotics, as well as a number of activities related to IT, including the creation of detection and identification algorithms and designing web applications (WebAPI).

We also conduct field measurement campaigns, which usually last up to several working days. Operational remote sensing work is conducted for each land cover type. These are usually agricultural and forest areas, urbanized and industrial spaces. Depending on the scope and nature of the analyses carried out, the appropriate time and equipment with the relevant technical parameters are selected.

Basic equipment:

- Various types of aircraft (for subsystem testing and data acquisition).
- Laboratory spectrometers (for laboratory acquisition of spectral curves).
- Multispectral cameras (from 2 to 12 spectral bands).
- Specialized cameras from leading manufacturers (mid and far infrared).
- Photogrammetric station (for processing metric and non-metric images).
- Precision GPS-RTK receiver (for field measurements and navigation).



Technical data:

- Wingspan: 3.85 m.
- Take-off weight: 25 kg.
- Payload: 4.2 kg.
- Flight altitude: 3500 m AMSL.
- Flight time: 45 minutes.
- Speed: 35 m/s.



## PHOENIX

The Phoenix (1:10) is a remote-controlled fixed-wing aircraft with push electric drive and can be equipped with photovoltaic panels. Thanks to the autopilot system, the model can perform missions in automatic, semi-automatic and manual modes. It is mainly used for testing on-board systems and carrying a variety of cameras. It is adapted for terrain mapping and in particular for acquiring images of agricultural and forest areas.

Typical activities performed in the field:

- Testing and calibration of measurement systems.
- Local inspection, site reconnaissance and field matrix measurements.
- Preparation of photogrammetric matrix prior to photo airborne mission.
- Acquisition of photographic material (from the ground and from the air).
- Collection of water, soil and vegetation samples.
- Field measurement of spectral curves.
- Collection of data and creation of mapping studies.

## CREATION OF VEGETATION INDICES AND VEGETATION TESTING

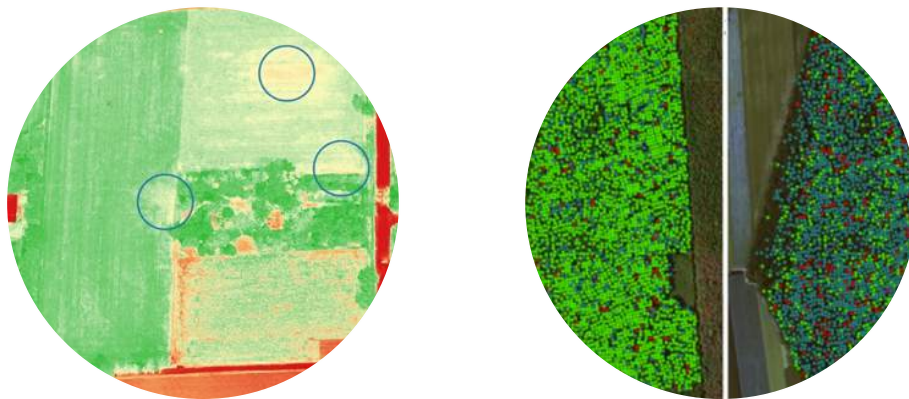
Much of the work performed is classical remote sensing analysis based on airborne and satellite imaging.

These include indicator analyses and advanced processing based on machine learning algorithms. The results of these activities include land cover classification, anomaly or damage detection (e.g. within agricultural crops) or maps of distribution of specific phenomena (e.g. content elements in biomass or soil).

## FOREST MANAGEMENT

In the framework of the projects carried out in the Institute and pilot projects conducted at the partners', new methodology of forest area survey from the air and satellite range has been developed.

The works have used the multispectral platform built for this purpose and new algorithms for data fusion. The application of the unmanned aerial system designed for acquisition of multispectral terrain data enables mapping areas of up to several km<sup>2</sup> during a single flight. Data processing techniques include advanced algorithms for statistical analysis.

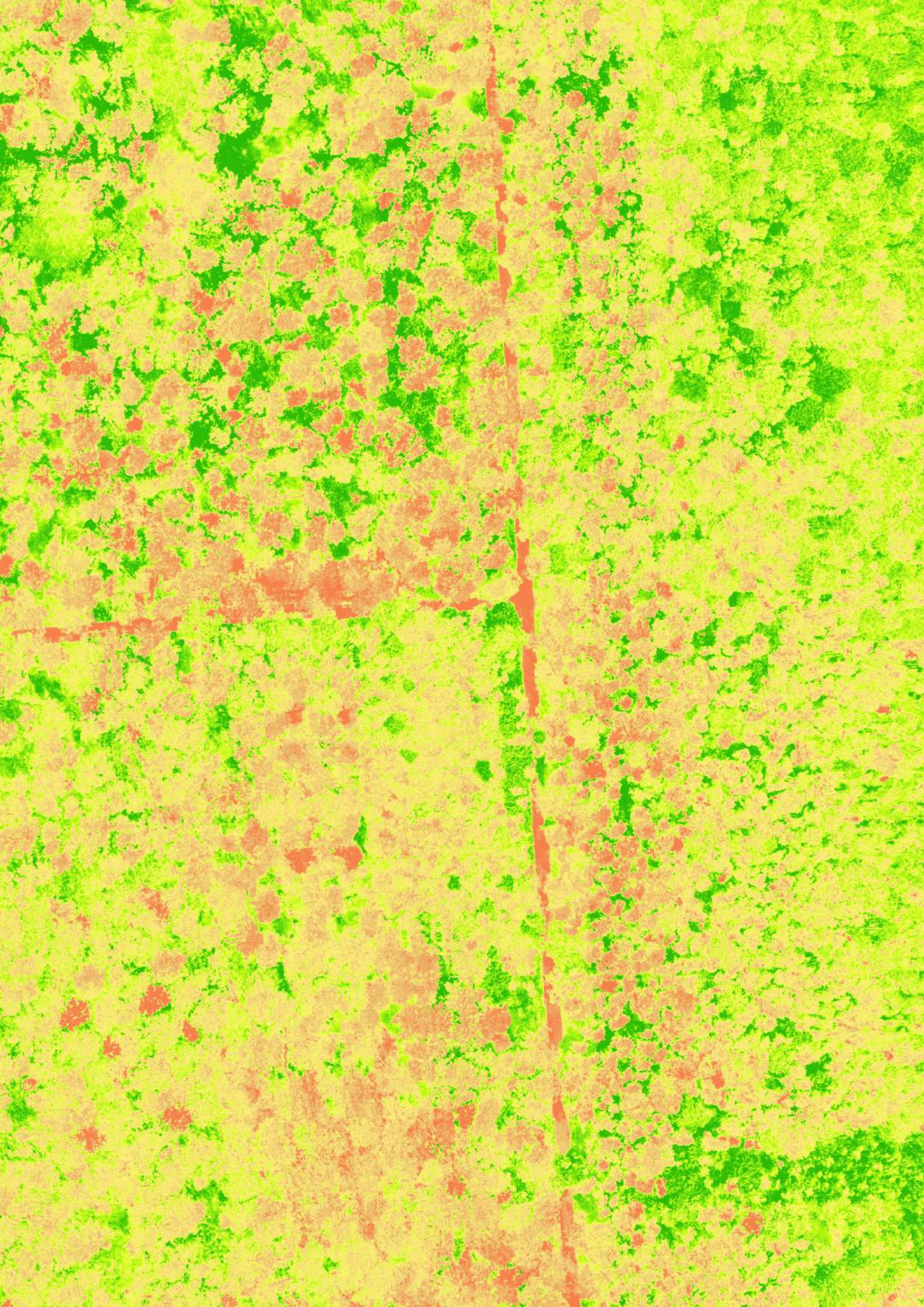


## WATER TESTING

Łukasiewicz Research Network - Institute of Aviation conducts a number of tasks related to the studies on inland and sea waters. These are, among others, projects related to cyclical monitoring of cyanobacteria (in cooperation with IOP PAN) or selection of optimal sites for installation of water turbines on the basis of geoinformation analyzes based on proprietary analyzes of the landform and the nature of the river basin. Moreover, Łukasiewicz - Institute of Aviation performed tasks in the field of water-related infrastructure monitoring, including: sewage treatment plants, pipelines, collectors (including the effects of their breakdowns).



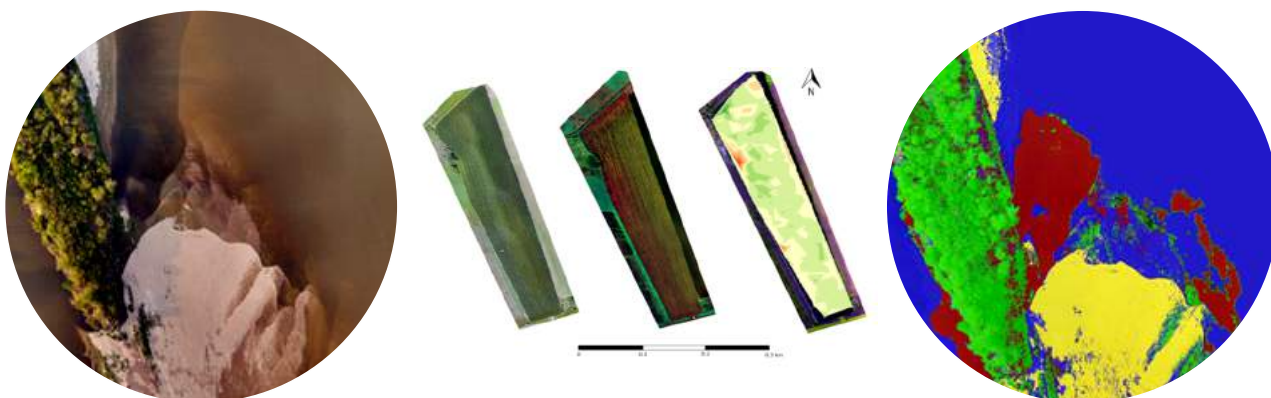




## SOIL SCIENCE

Soil testing conducted at regular intervals is a requirement of good agricultural practice. The physical and chemical properties and elemental composition of the soil have a major impact on fertilizer application plans and crop yields. Work in this area requires the use of advanced analysis with simultaneous collection of multiple field samples.

Mobile Soil Mapping System for Crops, built at the Łukasiewicz Research Network- Institute of Aviation, is an automatic mobile robotic platform that enables to analyze the structure and properties of soils with simultaneous determination of biochemical vegetation in order to understand the relationship between irrigation and yield quantity and quality. The advanced analyses are based on both reference spectrometer data as well as hyperspectral and multispectral images acquired from the air.



## MONITORING OF THE EFFECTS OF POLLUTION

The most important remote sensing projects carried out in the Łukasiewicz Research Network - Institute of Aviation include projects related to nature protection and monitoring of crisis events. An example of such work is monitoring and classification of stagnant sewage ponds in the Vistula riverbed. Additionally, various projects connected with remote sensing of pollution in inland and sea waters, soil and biomass are carried out.

## SPECTRAL ANALYSES

Advanced spectral analysis is designed to analyze and identify objects. Reflectance is a characteristic parameter from which it is possible to deduce the composition and physical and chemical properties. Based on the analysis of spectral curves, it is possible to perform detection without direct contact with the investigated object.

## AERIAL DATA ANALYSIS

Łukasiewicz Research Network - Institute of Aviation conducts a variety of industrial and R&D projects. Each time during tests and measurement campaigns huge data sets are collected and used for advanced analyses. In order to process them efficiently and effectively, a special technical infrastructure has been created. It supports all activities related to handling data collected with various tools.

## MODERN AGRICULTURE

Łukasiewicz Research Network - Institute of Aviation is involved in advanced work for modern agriculture, which is reflected in participation in research projects aimed at, among others, development and implementation of ways to use modern technologies of remote sensing in the process of sustainable production of competitive healthy food with particular emphasis on crop inspection.

## LABORATORY OF SPECTRAL SIGNATURES

Łukasiewicz Research Network - Institute of Aviation offers a laboratory to provide for the analysis of aerial and satellite images, as well as unmanned space missions, the reference data allowing to identify objects registered in the ultraviolet, visible and infrared bands.

Three spectrometers are available to measure spectral signatures in the range from 200 nm to 25,000 nm for liquids, suspensions, and solids. The laboratory is also equipped with a soil NPK analyzer and a fluorimeter to determine the condition of plants. In order to meet the needs of the laboratory, a specialized station was constructed to obtain multispectral images of the material tested. It is equipped with a multispectral camera (range 460-1100 nm), narrow band interference filters, markers with reflectance <5% and reflectance >95%, and an illumination system with characteristics similar to the solar spectrum. Additionally, the laboratory is equipped with an XRF spectrometer with X-ray range, which is used to identify elements in a given substance and determine their quantity.

So far, the laboratory has conducted experiments for monitoring water content in biomass, tests on aerosols (including greenhouse gases: H<sub>2</sub>O, CO<sub>2</sub> ), bacterial suspensions with characteristics similar to the Lost City region on the mid-Atlantic ridge (methanogens), fertilizers (NPK), potassium salts, ammonium salts, volcanic, magmatic, sedimentary rocks.

Methods for sharing acquired multispectral data include direct integration with cloud-based data repositories.

## OPERATIONAL CENTER FOR EARTH OBSERVATION MISSIONS

Łukasiewicz Research Network - Institute of Aviation uses its own Operational Center for Earth Observation Missions, which is responsible for acquisition, archiving, processing, visualization and sharing of different types of data.

The Center consists of six essential elements:

1. An assembly of antennas for satellite scene acquisition.
2. An assembly of advanced workstations.
3. Data repository.
4. Computational cluster.
5. Data visualization assembly:
  - Workstation capable of displaying data on 12 UHD monitors.
  - 8 UHD monitors.
6. Proprietary software for data acquisition, archiving, processing, visualization and sharing.

The Center is designed to collect a wide range of data from various stationary and mobile sensors. In the case of precision farming, this can be of importance in plant care, where the control of the sprayer enables targeting specific areas with an increased or reduced dose of fertilizers or plant protection products.

Through extensive use of wireless communications, between the Center and field stations, information can be generated virtually at the time of source data acquisition regardless of the place of its generation and then the products are made available wherever they are needed, also regardless of the place of their destination.

An important element of the Center is specialized photogrammetric and remote sensing software as well as software for creation and management of Spatial Information Systems. It allows for professional processing of the acquired data and the creation of products such as land surface models, orthophotomaps and specialized vector maps.

# MEANS OF TRANSPORT

Institute has a portfolio of ground, surface and underwater vehicle testing. The laboratory infrastructure used for testing includes the Central and Eastern Europe's largest wind tunnel and a laboratory for environmental tests.

## AUTOMOTIVE

In addition to scaled vehicle models, the Institute also tested racing cars constructed by student teams. The improvement of aerodynamic characteristics enabled these vehicles to win high positions in international competitions.

### AERODYNAMIC RESEARCH LABORATORY

The laboratory conducts:

- Weighting tests, taking into account the influence of the sideslip angle and speed change on the aerodynamic characteristics of the car.
- Measurement of pressure distributions in two cross-sections - in front of the car and in the driver's seat, as well as in the longitudinal symmetry axis of the car.
- Flow visualisation with use of regular and mini tufts.

The Laboratory has implemented:

- Quality Management System in accordance with the requirements of PN-EN ISO 9001:2015.
- Laboratory Management System in accordance with the requirements of PN-EN ISO/IEC 17025:2018-02.
- Internal Control System Criteria.

Technical test results obtained in the laboratory are recognized by both the International Standard Organization ISO and by the International Laboratory Accreditation Cooperation ILAC.

Since 22 October 1997 the Laboratory has held the Accreditation Certificate No AB 129 granted by the Polish Center of Accreditation.



PALENIE  
WZBUDZONY



## RAILWAY

Activities conducted in the Łukasiewicz Research Network - Institute of Aviation in the area of works for railroad industry include tests of resistance and strength to the impact of mechanical environmental factors (vibrations, shocks) and climatic factors (temperatures, increased humidity). Tests are carried out by qualified personnel of the environmental testing laboratory having competence and expertise in the scope of performed activities.

### ENVIRONMENTAL TESTING LABORATORY

The laboratory performs tests of such systems and devices as:

- Closed circuit television systems.
- Single-sided and double-sided information displays.
- CAMERA fiber video systems.
- Passenger information systems.
- Systems of remote control and direction of railroad traffic.
- Track occupancy control systems.
- Toll collection systems.
- Axle counting systems with wheel sensor.

The laboratory cooperates mainly with the Railway Institute for which it is a qualified supplier of tests, but also with companies of the railroad industry such as:

- Kolejowe Zakłady Automatyki KZA Kraków.
- Kolejowe Zakłady Łączności KZŁ Bydgoszcz.
- KONBUD Radom.
- Sat-System.
- Voestalpine Signaling Poland.

Test results are the basis for the certification of tested devices and their implementation in rail vehicles.

The laboratory has the Accreditation Certificate of Testing Laboratory No. AB 132 confirming compliance with the requirements of PN-EN ISO/IEC 17025:2018-02 issued by the Polish Center of Accreditation. The scope of accreditation includes testing of resistance to mechanical and climatic exposure and functional testing of products.

### ENGINEERING SERVICES CENTER

The Institute cooperates with the world leader in the transportation industry - Wabtec, for which Warsaw engineers carry out reliability analyses and prepare analytical tools and forecasting algorithms to optimize the life cycle of locomotives. The services are performed under a long-term cooperation agreement.

### AERODYNAMICS DEPARTMENT

The Institute has also experience in designing forced ventilation systems for passenger compartments of railway vehicles.



# SYSTEM STEROWANIA TUNELEM

Identyfikator	Status	Wartość	Opis
001	ON	12.5	Stacja 1
002	OFF	0.0	Stacja 2
003	ON	8.7	Stacja 3
004	ON	15.2	Stacja 4
005	OFF	0.0	Stacja 5
006	ON	9.1	Stacja 6
007	ON	11.3	Stacja 7
008	OFF	0.0	Stacja 8
009	ON	7.8	Stacja 9
010	ON	13.6	Stacja 10

System sterowania tunelem z diagramem sieci i panelami danych.

Parametr	Wartość
CIŚNIENIE WYCIĄGOWE (Pa)	0.00
CIŚNIENIE WENTYLATORA (Pa)	0.000

Menu: Główny, Nowy, Zarządzenie, Rejestracja, Systemowy

# CONSTRUCTION

The experience gained in the aviation industry is also used for the needs of the construction sector. The Institute provides services in the field of non-aviation aerodynamics and remote sensing.

## AERODYNAMIC RESEARCH LABORATORY

The laboratory conducts tests including:

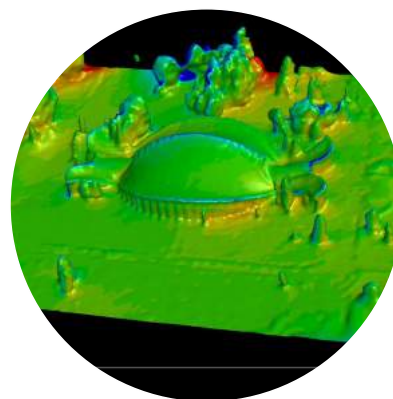
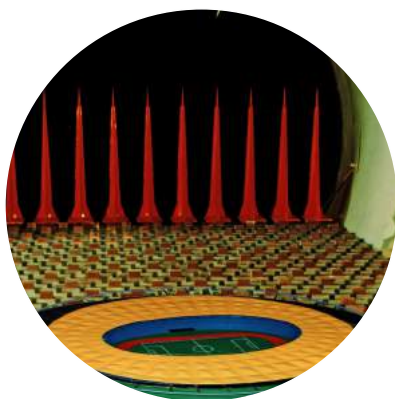
- Flow analysis around large above-ground structures such as buildings, stadiums, bridges.
- Simulation of air movements in urban agglomerations; safety analysis of high altitude rescue operations in such agglomerations.
- Analysis of the aerodynamics and loads of structures subjected to strong effects of the fluid medium (aerodynamic or hydrodynamic forces, strong wind gusts).
- Analysis of wind resistance of civil engineering objects.

Tests are conducted for models of objects generating aerodynamic resistance (residential and public buildings, bridges, industrial constructions) of height up to 3 m or cross-section (perpendicular to the direction of flow) up to 2,5 m<sup>2</sup>.

The Laboratory has implemented:

- Quality Management System in accordance with the requirements of PN-EN ISO 9001:2015,
- Laboratory Management System in accordance with the requirements of PN-EN ISO/IEC 17025:2018-02,
- Internal Control System Criteria.

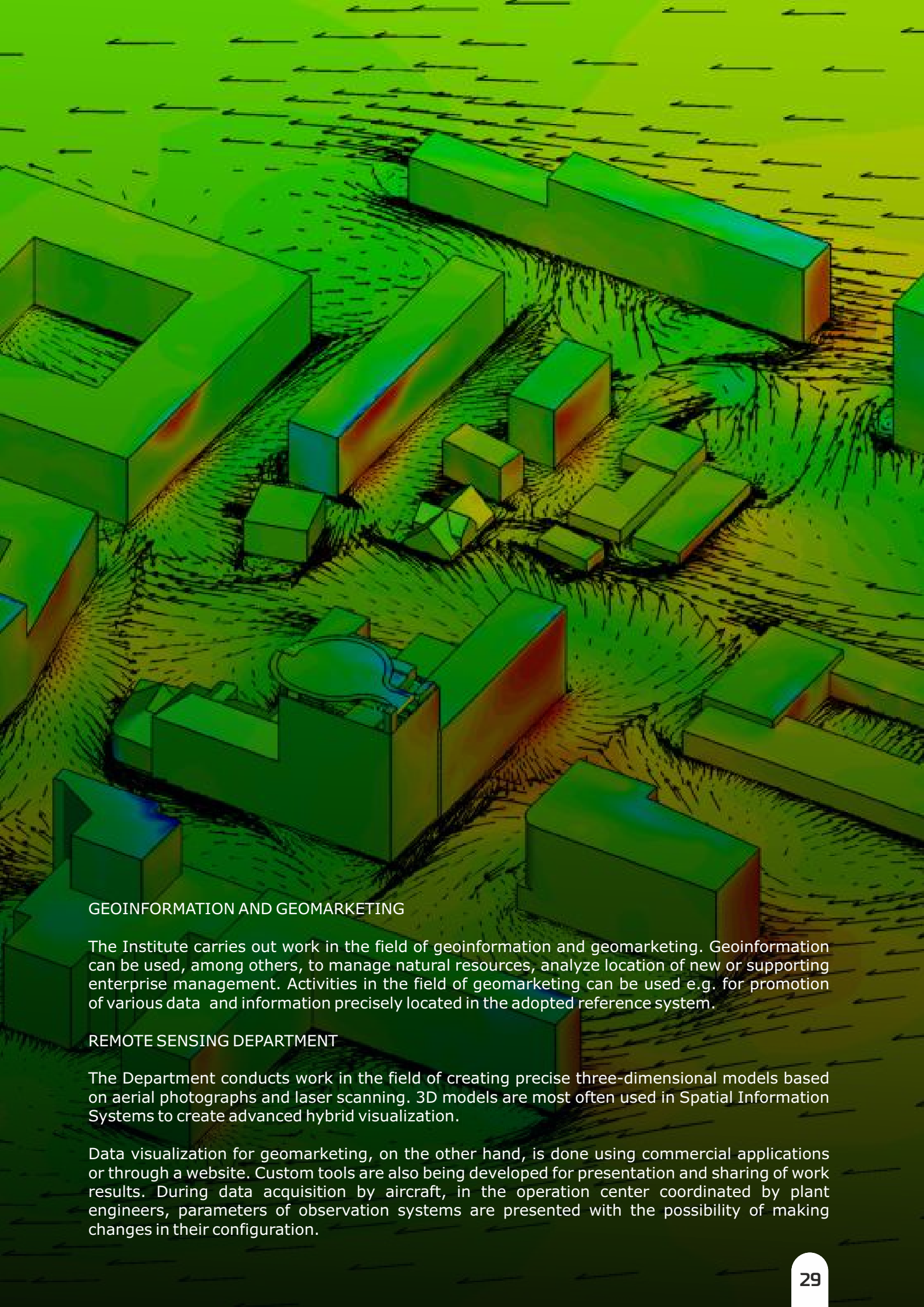
The technical test results obtained in the laboratory are recognized by both the International Standard Organization ISO and by the International Laboratory Accreditation Cooperation ILAC. Since 22 October 1997, the Laboratory has held the Accreditation Certificate No AB 129 granted by the Polish Center of Accreditation.



## COMPUTATIONAL AERODYNAMICS DIVISION

The unit has extensive experience in performing computational fluid dynamics (CFD) analyses of structures such as skyscrapers and rooftop landing pads, together with the mapping of the close urban environment. The simulations allow for determination of wind or snow loads on facades or roofs of buildings or assessment of wind comfort in their surroundings.





## GEOINFORMATION AND GEOMARKETING

The Institute carries out work in the field of geoinformation and geomarketing. Geoinformation can be used, among others, to manage natural resources, analyze location of new or supporting enterprise management. Activities in the field of geomarketing can be used e.g. for promotion of various data and information precisely located in the adopted reference system.

## REMOTE SENSING DEPARTMENT

The Department conducts work in the field of creating precise three-dimensional models based on aerial photographs and laser scanning. 3D models are most often used in Spatial Information Systems to create advanced hybrid visualization.

Data visualization for geomarketing, on the other hand, is done using commercial applications or through a website. Custom tools are also being developed for presentation and sharing of work results. During data acquisition by aircraft, in the operation center coordinated by plant engineers, parameters of observation systems are presented with the possibility of making changes in their configuration.



# DEFENCE INDUSTRY

The Institute has specialized for many decades in work for the defence industry, including the design and testing of systems such as missiles and flying targets. At present, the Institute is developing the ILR-33 AMBER 2K suborbital vehicle - the world's first rocket using hydrogen peroxide with a concentration exceeding 98%. The Institute also offers specialised aerodynamic and environmental testing of military equipment.

## SPACE TECHNOLOGIES DEPARTMENT

As part of the work carried out in the Space Technologies Department, a number of competences were developed along with technologies that are applied to support the development and research of dual use systems.

### 1. ILR-33 AMBER 2K

The developed platform can be used as a ballistic target imitator providing, among others:

- Training system support.
- Support for testing of radar systems.
- Potential use of the platform for ballistic missile defence threat imitation.
- Ground segment testing. The use of vehicle using a hybrid rocket motor and several possible configurations of solid rocket boosters allows for accurate execution of various missions and to adapt the flight profile to specific military training scenarios and demanding requirements.

### 2. Flight Simulator

Original software for simulating flights of various types of missiles (6 degrees of freedom simulation) allows for matching desired performance (trajectory, guidance navigation and the mission envelope determining specific locations of air-dropped objects). It is a key tool in planning and conducting flight tests of missiles. It allows to ensure an appropriate level of safety of tests and supports decision-making processes and technology development. It also allows to deliver performance charts for proven designs.

### 3. Navigation and control systems

Łukasiewicz Research Network - Institute of Aviation has successfully completed a project entitled: "Gasodynamic Missile Actuation Systems" commissioned by MESKO S.A. (within the project funded by National Center for Research and Development). The system demonstrator has been developed and tested in-flight mode. The aim of the project was to demonstrate the possibility of conducting a precise low-altitude manoeuvre the missile after the so-called cold launch, i.e. after leaving the launcher without using the main propulsion system. The developed know-how, so far mastered by only a few countries, may be used in missiles systems.

In addition, on the basis of the AMBER rocket project, know-how was developed in the field of:

- Conventional controls systems.
- On-board computers.
- Telemetry systems.
- Inertial navigation systems.



J1

J3

#### 4. Rocket Propulsion Technologies

While carrying out a number of projects aimed at developing chemical propulsion systems for suborbital rockets, missiles and spacecraft, Łukasiewicz - Institute of Aviation is able to design and test solid, hybrid and liquid propellant systems with a customer-specified performance profile. Highly innovative propulsion systems, such as hypergolic propulsion (reignitable and throttleable) are developed by the Institute. The solutions used are mainly based on future-oriented green storable propulsion technology and advancements in energetic materials are also being made.

##### AERODYNAMIC RESEARCH LABORATORY

The Laboratory carries out tests of aerodynamic characteristics of weapon elements and testing of wind resistance of systems such as radars, etc.

The Laboratory has implemented:

- Quality Management System in accordance with the requirements of PN-EN ISO 9001:2015,
- Laboratory Management System in accordance with the requirements of PN-EN ISO/IEC 17025:2018-02,
- Internal Control System Criteria.

Technical test results obtained in the laboratory are recognized by both the International Standard Organization ISO and by the International Laboratory Accreditation Cooperation ILAC.

Since October 22, 1997, the Aerodynamic Testing Laboratory has held the Accreditation Certificate No AB 129 granted by the Polish Center of Accreditation.

##### ENVIRONMENTAL TESTING LABORATORY

Activities conducted at Łukasiewicz Research Network - Institute of Aviation in the area of projects for the military industry include the testing of resistance and durability of devices and systems to the impact of environmental factors - mechanical (vibrations, shocks) and climatic factors (temperature, increased humidity, lowered pressure, precipitation, salt fog, solar radiation, frost and internal icing, dust and sand). Tests shall be performed by qualified personnel of the environmental testing laboratory having competence and expertise in the field of conducted tests.

Tests are carried out on such systems and devices as:

- Aerial radio altimeters.
- Aerial Fuel Meters.
- Helicopter engine shaft torque measuring systems.
- Helicopter weapon system cartridge counters.
- Interference flares for military aircraft.
- Unmanned aerial objects and their systems.
- Communications systems.
- Military vehicle power systems components.
- Military aircraft control systems.
- Autopilot components and systems.

# SPORT

Łukasiewicz Research Network - Institute of Aviation has the largest wind tunnel in Central and Eastern Europe, which also serves the needs of the sports sector. In the past, the national ski jumping team members had their trainings in the tunnel.

## AERODYNAMIC RESERCH LABORATORY

The laboratory conducts tests in the field of aerodynamics of sports equipment (e.g. sleds, elements of ski suits), conducts research into the coefficients of resistance of bicycle frames (special test stands), and enables conducting training sessions for sports disciplines requiring simulation of air motion.

The Aerodynamic Testing Laboratory has implemented:

- Quality Management System in accordance with the requirements of PN-EN ISO 9001:2015 standard.
- Laboratory Management System in accordance with the requirements the PN-EN ISO/IEC 17025:2018-02.
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Since October 22, 1997, the Aerodynamic Testing Laboratory has held the Accreditation Certificate No AB 129 granted by the Polish Center of Accreditation.

## COMPUTATIONAL AERODYNAMICS DIVISION

The unit is experienced in computational fluid dynamics (CFD) simulations of bicycle frames along with optimization of their shape to minimize the drag coefficient.





# COOPERATION

The Institute provides engineering and research services under commercial commissions and long-term contracts with corporate clients. Exceptional engineering competencies are also gained, among others, through a strategic alliance with an American technology company:

- We operate globally and locally.
- We design.
- We support operations.
- We research and test.

## PUBLIC-INDUSTRIAL PARTNERSHIP

- Since 2000, the Institute has been developing cooperation with the world leader in engineering - General Electric.
- Both institutions launched one of the largest engineering organizations in Europe - Engineering Design Center, which carries out engineering and test services based on a wide, and continuously expanding, spectrum of its employees' competencies.

## CORPORATE CUSTOMERS

- The Institute provides engineering services in the field of analysis and design, as well as research and development for corporate clients under long-term cooperation (Baker Hughes, Innio, Wabtec).
- The services are performed within the Engineering Services Center, established especially for that purpose.

## COMMERCIAL ORDERS

- The Institute provides research services for domestic and global, various industries.
- Thanks to the developed laboratory infrastructure it is possible to provide comprehensive and advanced research and services.









# CONTACT

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