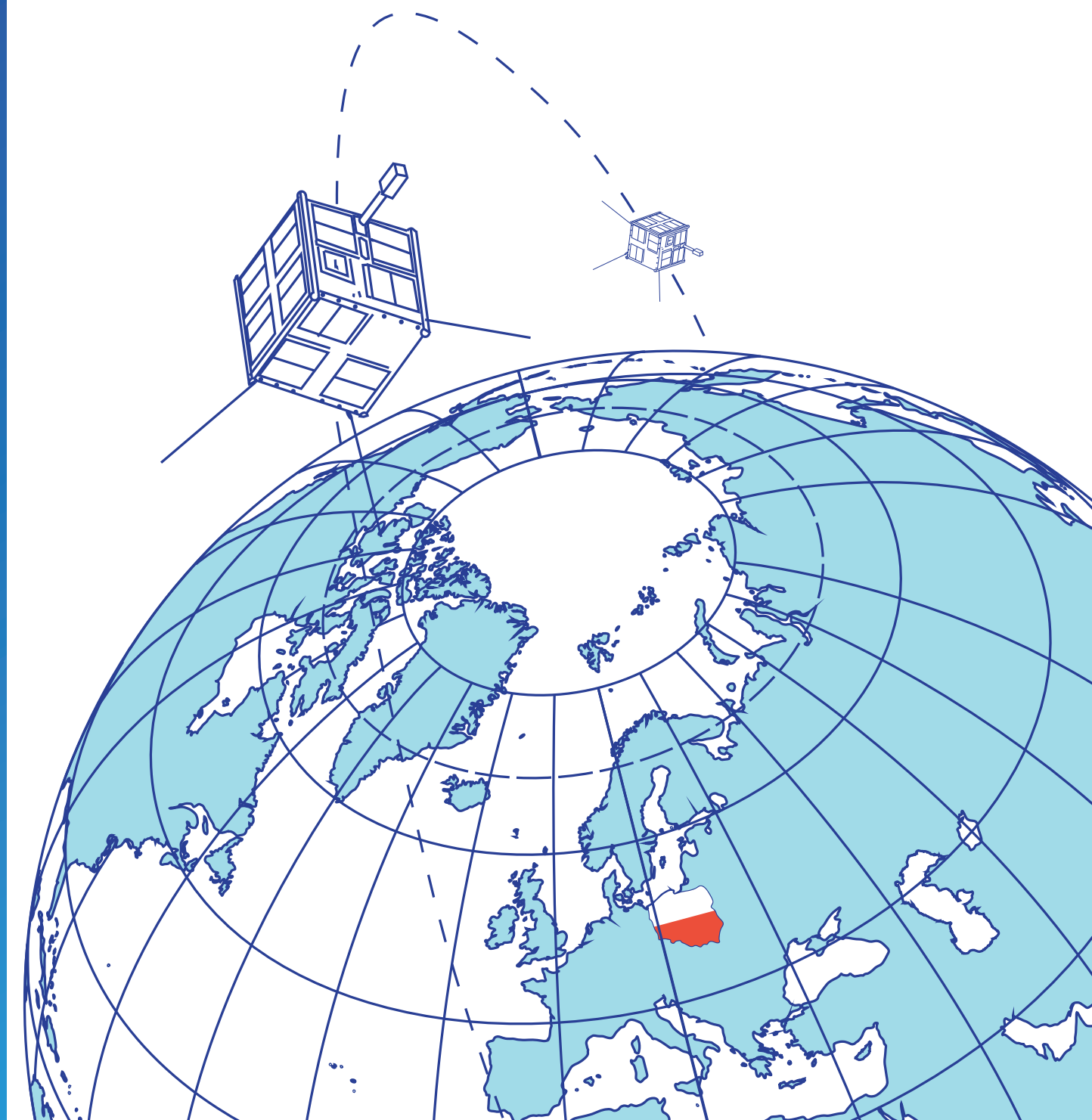


POLISH SPACE SECTOR

CATALOGUE OF SELECTED ENTITIES

2018



SYDRAŁPOLSKA



SpaceForest
INNOVATIVE SOLUTIONS



ABM SPACE



HERTZ
SYSTEMS



newind
SATREVOOLUTION



KP LABS

Silesian Science
and Technology
Centre of Aviation
Industry Ltd.



ProGed 4P



ThalesAlenia
Space

AIRBUS

Astronika



SKA Polska



gmv

CRVO TECH
INSTRUMENTS S.A.



Institute of Aviation

ASCTI POLSKA

SPACIVE



SENER

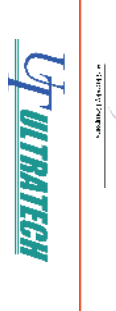
mbroTECH

mbroTECH



GJSECO
POLAND

pzmi elec



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INTRODUCTION



Ladies and Gentlemen,

The catalogue of Polish space sector entities, which I am pleased to present to you, is the second publication of the Polish Space Agency. This catalogue constitutes a compilation of industrial and research capabilities related to the exploration and use of space, and Polish expertise in this field.

Poland takes pride in over 40 years of experience in space research and exploration. During this period, Polish scientists and engineers designed and constructed over seventy instruments used in space missions such as Cassini-Huygens, Mars Express, Rosetta, Venus Express, Herschel and Phobos-Grunt. The leading role in this field is played by the Space Research Center of the Polish Academy of Sciences - the only Polish institute whose principal activity is related to conducting research in space, the Solar System and Earth itself using space technologies and satellite techniques.

Poland's accession to the European Space Agency (ESA) in 2012 became a catalyst for the development of the Nation's domestic space sector. Within ESA programmes over the last 6 years, Polish entities have secured over 330 contracts, for a total amount of almost EUR 100 million.

The Polish Space Strategy, adopted in 2017 – the fundamental document of Polish space policy – assumes that, by 2030, the Polish space sector will be able to effectively compete on the European market, and its share will amount to at least 3 percent of the total market. This is an ambitious goal, but an achievable one, which will be implemented, alongside others, via the National Space Program, which we are currently working to develop, in order to fully meet the expectations and the needs of the Polish space market.

I hope that the following catalogue will serve as a useful source of information about the Polish space sector and will enable space entrepreneurs to establish valuable business contacts.

I wish you an interesting read.

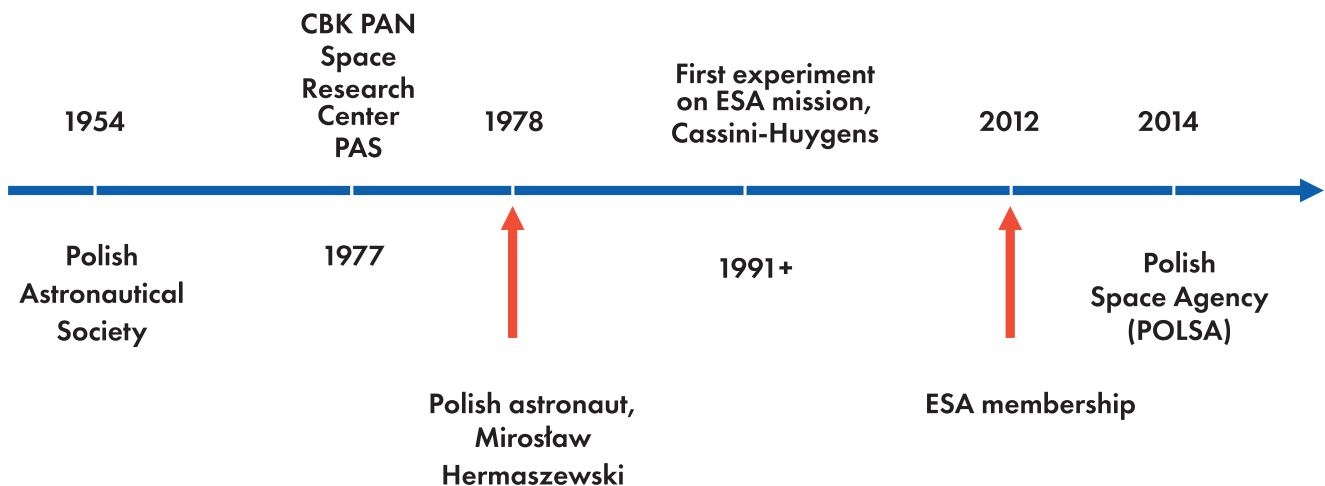
Grzegorz Brona Ph.D.
President



Space sector in Poland

The Polish space sector began taking shape in the 1970s, when institutes of the Polish Academy of Sciences, led by the Space Research Centre, initiated scientific, R&D, and implementation activities in the fields of space and satellite technologies. Instruments designed and constructed by the institutes were used in over 70 international space missions, such as Cassini-Huygens, Mars Express, Rosetta, Herschel, PROBA-3, and InSight.¹

The advent of cooperation with the European Space Agency (ESA) and execution of the Plan for European Cooperating States in 2007 became catalysts for the development of the domestic space sector in Poland. Polish space research and industry representatives are now afforded the opportunity to participate in international space projects on a major scale. Poland became a full ESA member in 2012. Since then, Polish entities are active participants in ESA competitions – within the Polish Industry Incentive Scheme – PLIS, a programme dedicated entirely to Polish entities, as well as in mandatory and optional programmes. Along with their successful participation in numerous space projects, the experience of Polish entities in providing advanced technological solutions tested and demonstrated in Outer Space (*space heritage*) is constantly growing. Since Poland's accession to ESA, the number of Polish entities registered at the ESA EMITS portal has increased almost ten-fold (420 entities at the beginning of 2018 vs. 48 entities in 2012). Within the six years after becoming a full ESA member, Polish entities have so far obtained over 330 contracts commissioned by ESA, for a total amount of approximately 100 million euros.



Source: POLSA.

The Polish space sector is currently comprised of dozens of the most active SMEs (including branches of European space companies), a few large companies operating in the ICT (Information and Communication Technology), defence, and aviation industries, as well as prestigious technical universities. The Polish Space Industry Association was established in 2012, and currently represents over 60 companies and research centers. A vital segment of the community of stakeholders in the Polish space sector is formed by public administration entities, which create demand for solutions derived from satellite data utilization, serving as a means of improving the effectiveness of public administration activities (e.g., crisis management, spatial development, environmental monitoring).² The public administration sector also includes institutions responsible for shaping national space policy, with the leading role played by the Ministry of Entrepreneurship and Technology, whose representative serves as the head of the Polish delegation to ESA.

¹ *Polish Space Instruments period 1970-2016*, CBK PAN, Warsaw, 2016.

² *Polish Space Sector. Business Breakdown Structure – Possibilities of Development – Acquiring Funds* ed. M. Wachowicz, Polish Space Agency, Warsaw, 2017.

With the rapid development of the domestic space sector, Polish entities face new challenges. The Polish Space Strategy adopted by Council of Ministers Resolution of January 26th, 2017, directed, among other things, boosting the competitiveness of the Polish space sector, increasing its share of the European space sector, enhanced satellite applications development (contributing to the development of the digital economy), increasing the defensive capabilities of the country with the use of space and satellite technologies, and providing highly-qualified human resources for the Polish space sector, as the goals to be achieved by the sector.³

Polish space policy – key entities

Groups and committees

- **Interministerial Group for Space Policy in Poland** – This body is responsible for formulation of domestic space policy and coordinates the activities of public administration in the field by making key decisions, including financial directives.
- **Task Force PL–ESA** – This Task Force was established in order to secure the interests of domestic entities operating in the space sector, in cooperation with ESA. It is responsible for organizing the Polish Industry Incentive Scheme programme. The Ministry of Entrepreneurship and Technology coordinates the work of the group.
- **Task Force PL** – This group’s tasks include monitoring ESA expenditure on contracts with Polish entrepreneurs and making decisions supporting the Polish space sector in obtaining scientific-industrial projects, in order to optimize the use of Poland’s contributions to ESA.
- **Committee on Space Research of the Polish Academy of Sciences (KBKiS PAN)** – This Committee gathers experts and expertise in the field of space. It is responsible for integrating and stimulating domestic research, cooperating with and representing Poland at foreign and international research organizations, as well as assessing laws, regulations, and R&D draft programmes.

Ministries

- **Ministry of Entrepreneurship and Technology (MPiT)** – MPiT is the lead Ministry for Polish space policy implementation, representing Poland at the European Space Agency and at forums dedicated to EU space policy.
- **Ministry of Science and Higher Education (MNiSW)** – The Science Ministry is responsible for scientific research within domestic programmes of the National Centre for Research and Development (NCBR) and the National Science Centre (NCN), as well as international endeavors, such as Horizon 2020, Copernicus, and ESO programmes.
- **Ministry of National Defence (MON)** – The Defence Ministry is responsible for military space activities and utilization of space and satellite technologies for national security purposes. The Ministry’s principal areas of interest include SST/SSA, FLPP, and GOVSATCOM programmes. The Ministry cooperates with NATO and the European Defence Agency (EDA).
- **Ministry of Digital Affairs (MC)** – This Ministry leads the Galileo satellite navigation programme for Poland (except for the PRS segment – which falls under the Ministry of the Interior and Administration), as well as issues related to satellite communication.

³ Council of Ministers Resolution no 6 of January 26th, 2017, on adopting the Polish Space Strategy (M.P. item 203).

Non-governmental organisations

- **Polish Space Industry Association (ZPSK)** – This institution was established in 2012, joining and representing enterprises and research institutions involved in space activities. The association promotes economic development of the space industry in Poland. There are currently over 60 participating entities in the association.
- **„Aviation Valley” Association** – Established in 2003 in Rzeszów, this group represents the innovative aviation industry located in South-East Poland. There are currently 150 member organizations.
- **Polish Space Professionals Association (PSPA)** – The PSPA was registered in 2016, and actively engages in establishing contacts between Polish professionals operating in the domestic and foreign space sectors, as well as disseminating knowledge related to the space sector.
- **Polish Rocket Society (PTR)** – PTR is a nationwide organization established in 2010, associating rocket modelers and enthusiasts of experimental rockets and space technologies. One of the Society’s goals is to build rocket engines, rockets, and enlarge rocket-based activities in Poland.
- **Polish Astronaut Society (PTA)** – This is an association founded in 1954, bringing together experts who professionally deal with space issues, as well as enthusiasts in all spheres of space.
- **Polish Astronomical Society (PTA)** – This Society is a scientific association of professional astronomers, operating since 1923. The main goal of the Society’s activity is to popularize astronomy in society, including by organizing conventions, conferences, and workshops.
- **European Space Foundation** – The Foundation is an institution established in 2014, conducting educational and promotional activities in the field of space exploration, as well as supporting development of space policy in Poland, by organizing, for example, the European Rover Challenges in 2014, 2015 and 2016.
- **Mars Society Poland (MSP)** – The Polish branch of the Mars Society focuses on the promotion of research about the Red Planet and the vision for its colonization. The organization develops IT projects and supports projects of Mars rovers.
- **Association “Astronomy Nova”** – Established in 2009 in Częstochowa, the aim of the Association is to raise social awareness and engagement in the field of natural sciences, with particular emphasis on astronomy and its related sciences.

Other supporting entities

- **Industrial Development Agency JSC** – This is a state-owned enterprise, conducting projects supporting the space technologies sector, such as business incubators, internships, and training for young engineers.
- **Polish Space Agency (POLSA)** – POLSA is a governmental executive body, established in 2014. The tasks of the Agency include supporting science and industry representatives operating in the field of space and satellite technologies. POLSA’s leadership is carried-out through cooperation with the European Space Agency (ESA), the European Union (EU), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), with the goal of enhancing Polish participation in and contributions to European space projects. POLSA organizes several trade conferences annually, and is featured at domestic and international fairs associated with space, promoting Polish entities. All of these activities support POLSA’s establishment of contacts between domestic and foreign space sector entities and increasing awareness of the latest trends on the international space market.

The priority tasks of the Polish Space Agency also include increasing the defensive capabilities of Poland and assuring safety for its citizens through the use of space and satellite systems, as well as providing effective means of their utilization by public institutions. POLSA is responsible for preparing and implementing the National Space Programme. The Agency also conducts educational activities for primary and secondary schools in the field of space research, and additionally initiates and supports establishing new degree courses associated with space and satellite technologies at Polish higher education institutions.



Source: POLSA.

Polish space companies – characteristics

The Polish space sector companies presented in the following catalogue (34 entities) determined their areas of space activity by choosing up to 3 areas from the 14 fields listed below:

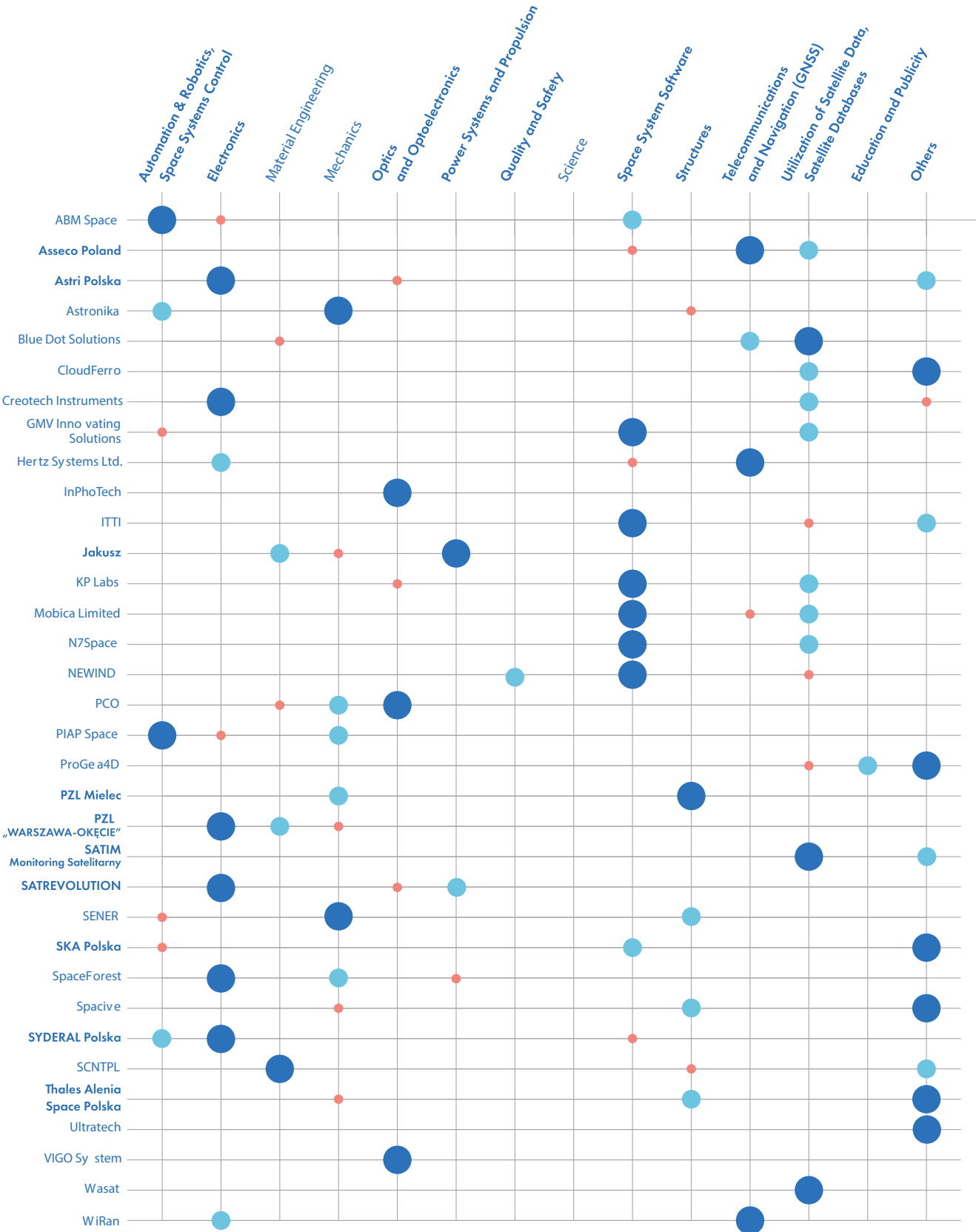
- Automation & Robotics, Space Systems Control;
- Electronics;
- Materials Engineering;
- Mechanics;
- Optics and Optoelectronics;
- Power Systems and Propulsion;
- Quality and Safety;
- Science;
- Space System Software: Ground Systems Software and On-Board Software;
- Structures;
- Telecommunication and Navigation (GNSS);
- Utilization of Satellite Data, Satellite Databases;
- Education and Publicity; or
- Other.

The chosen areas of space activity have been ranked in the order of precedence by each enterprise represented in the catalogue – in order to distinguish those areas comprising their core spheres of space activity.

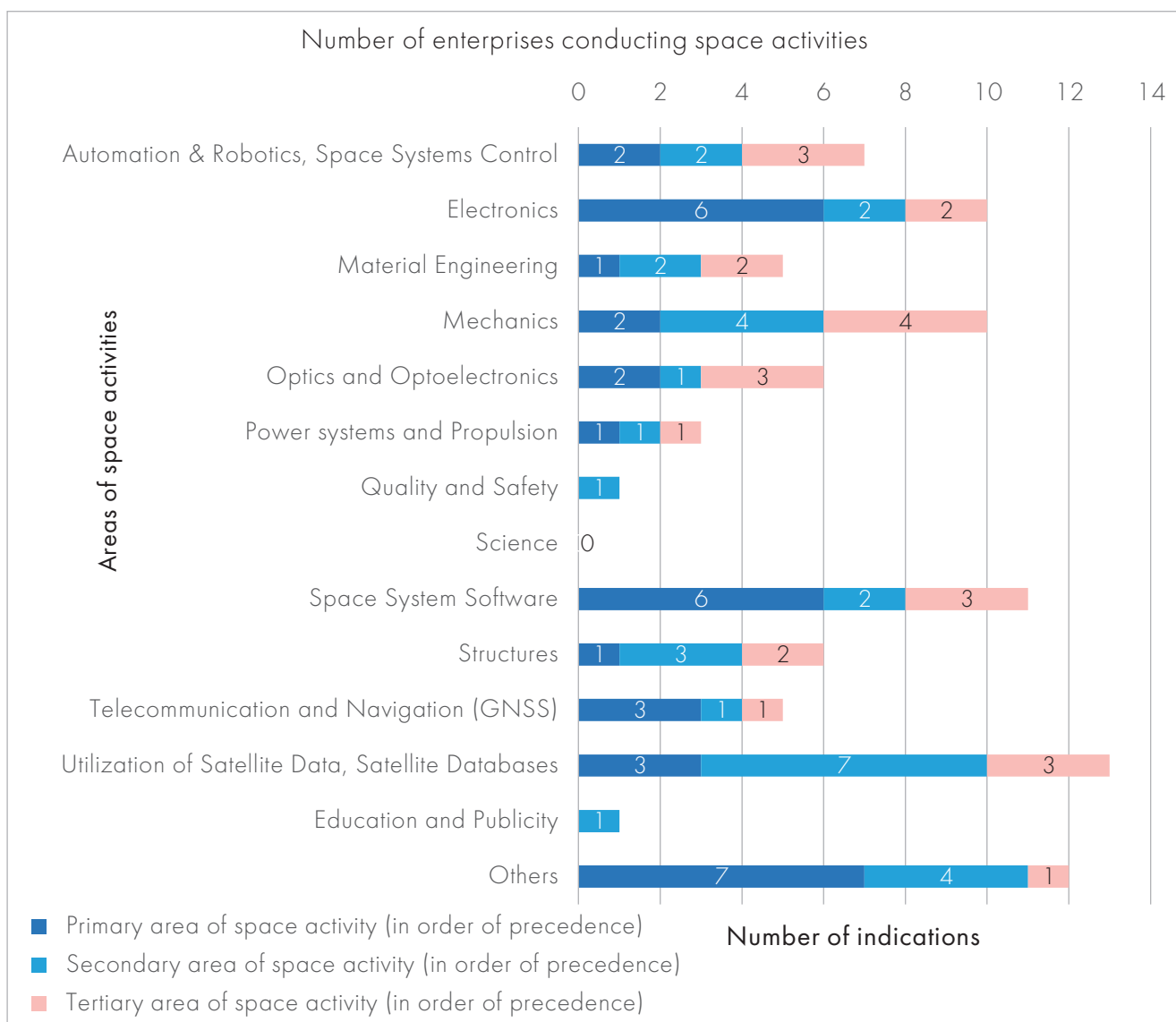
The areas of activity of the Polish space sector companies ranked in the order of precedence are illustrated by the chart below.⁴

⁴ Source: POLSA; based on data received from companies.

AREAS OF SPACE ACTIVITY OF COMPANIES IN ORDER OF PRECEDENCE



The chart below illustrates the number of enterprises conducting activity in given areas associated with space activity, along with their respective ranking, in order of precedence.



The 34 Polish space sector enterprises most frequently identified *Utilization of Satellite Data, Satellite Databases* (13 indications, where 10 entities ranked this sphere as a primary or secondary area) as their principal area of activity. *Space System Software: Ground Systems Software and On-Board Software* (11 indications, where 8 entities ranked this sphere as primary or secondary) came in second.

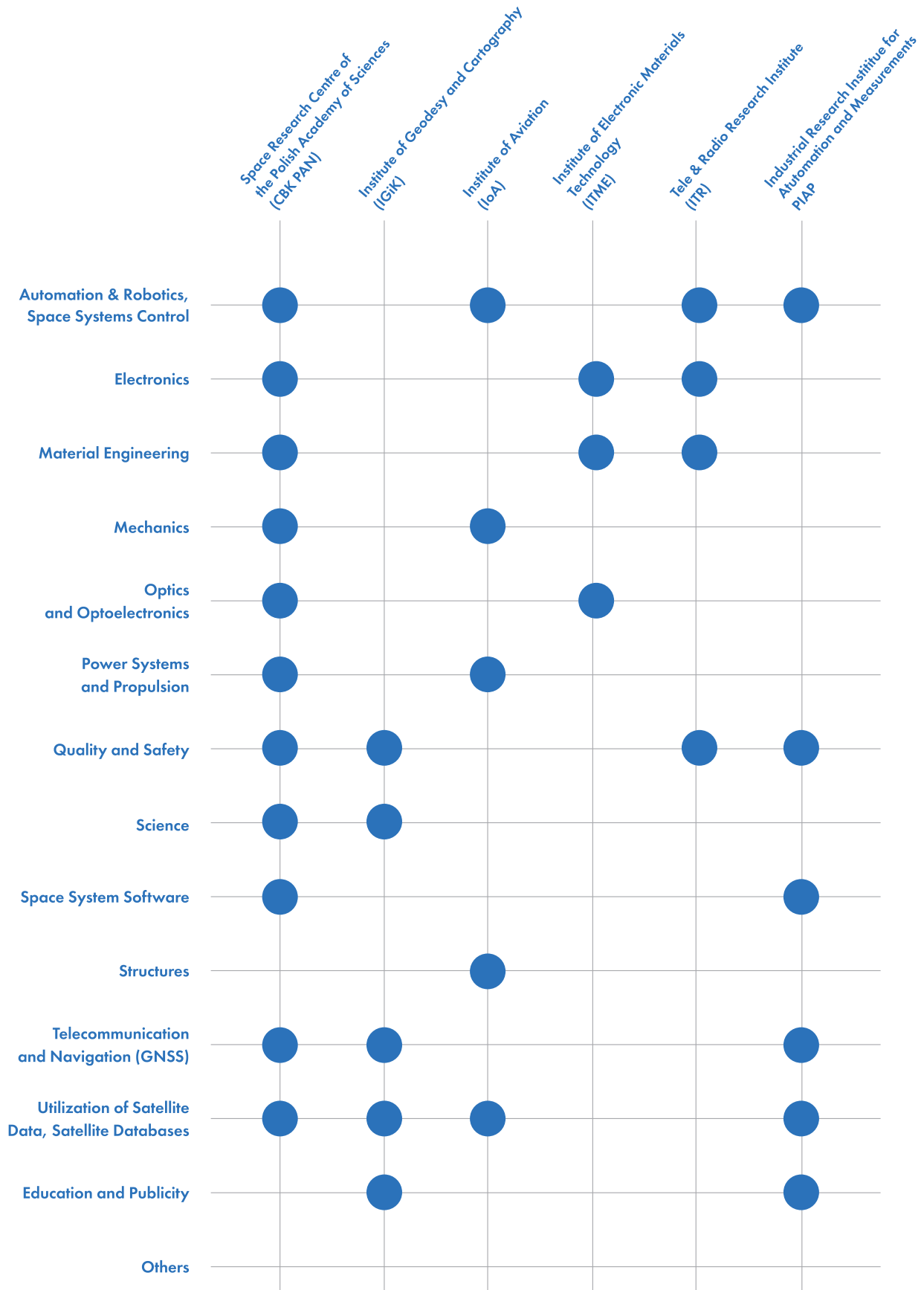
Electronics is also a significant area of activity of the Polish space sector (10 indications, where 7 entities ranked it as a primary sphere), along with *Mechanics* (10 responses) and *Automation & Robotics, Space Systems Control* (7 indications).

Research institutes conducting space activities

For the purposes of this catalogue, research institutes (6 entities) indicated their main areas of space activity from the list of 14 suggested endeavors. Due to a wide spectrum of space activities conducted by research institutes, as well as numerous departments and teams responsible for their respective spheres, ranking the areas of activity was not required. The institutes were also not required to limit themselves to the prescribed number of three ranked areas, as in the case of enterprises.

The areas of activity of research institutes operating in the space sector are illustrated by the chart below.⁵

AREAS OF SPACE ACTIVITY OF RESEARCH INSTITUTES



⁵ Source: POLSA; based on data received from research institutes.



**INDUSTRIAL
ENTITIES**

ABM Space Sp. z o.o.



ABM Space Sp. z o.o. specializes in the development of Solar System exploration analog robots. ABM Space robots are used for research purposes in extreme environments on Earth. The company was created based on the teams and Martian rover analog technologies built at Polish universities for the University Rover Challenge competition in Utah, US, between 2009 and 2013. ABM Space Sp. z o.o. implements developer solutions to use throughout project lifetimes and develops prototypes and solutions forming the basis enabling to create flight versions. Apart from building prototypes and participation in European Union-funded projects (e.g., Innovative Economy, international programs), the company offers sophisticated testing, analysis, and measurement services.

General information

Type of entity: **SME**

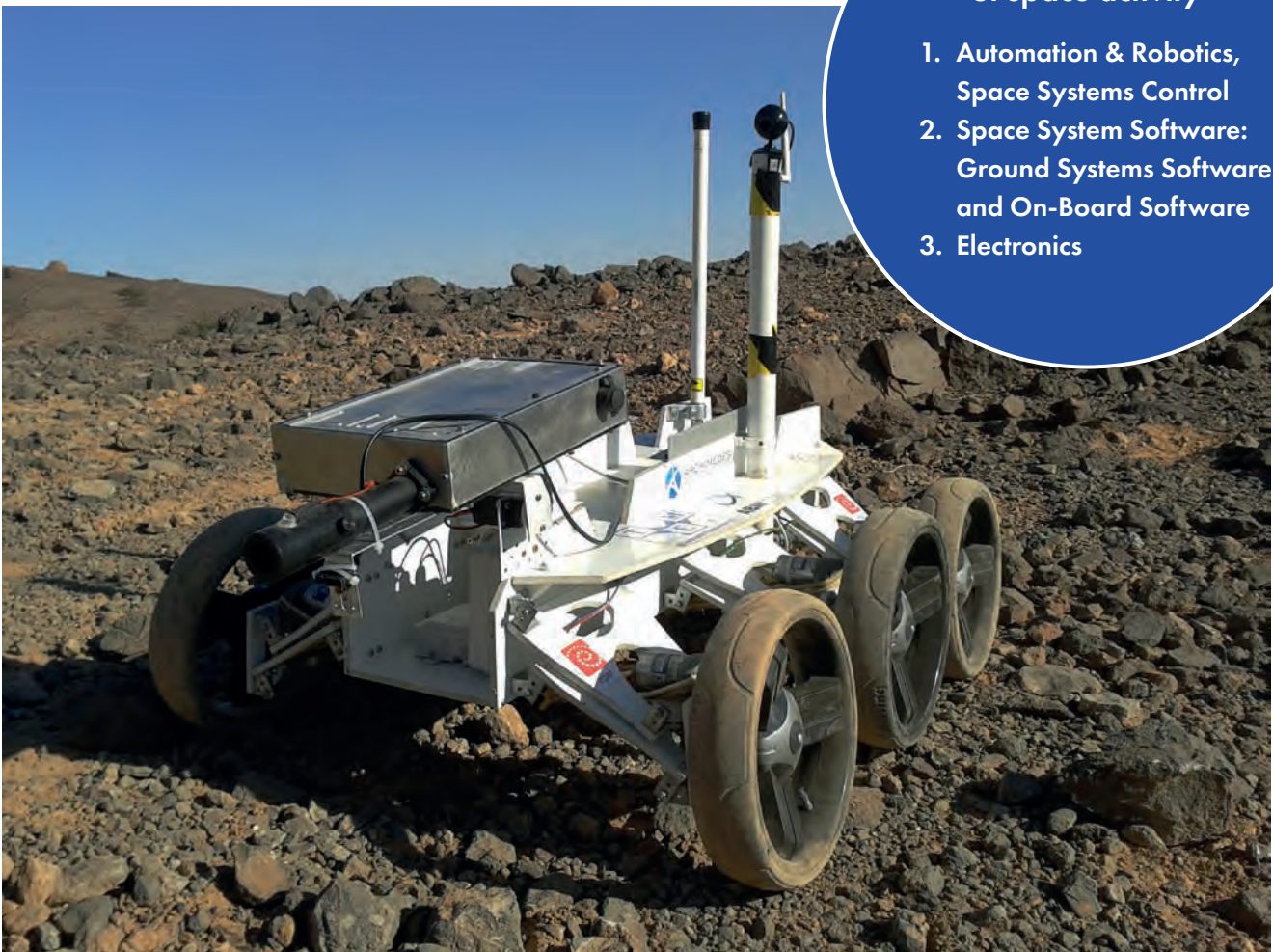
Type of activity: **research and services**

Total employment: **19**

Number of engineers and scientists: **9**

Main areas of space activity

1. Automation & Robotics, Space Systems Control
2. Space System Software: Ground Systems Software and On-Board Software
3. Electronics



Examples of completed or on-going space-related activities

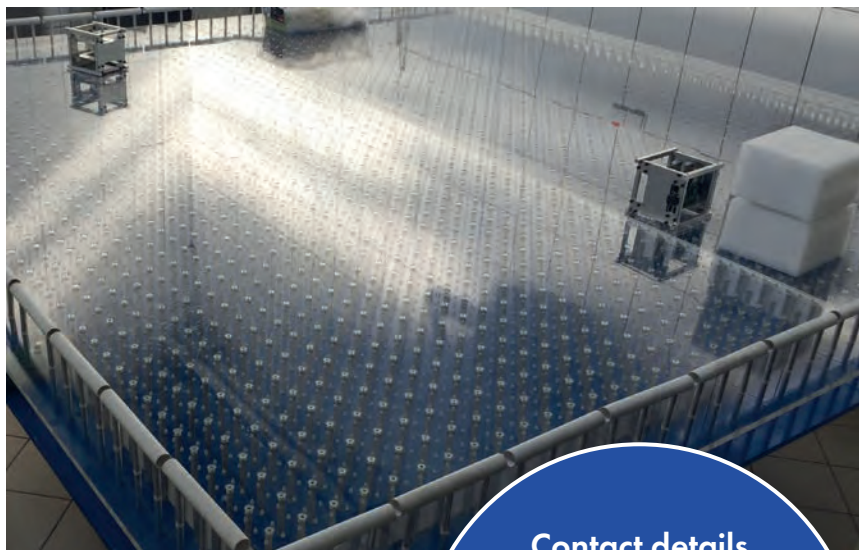
- **WIMR (Where Is My Rover)** – Global algorithms for positioning and navigation of a Mars rover, created using virtual environments and Mars surface analogs (mockups, natural terrain). The project does not utilize traditional satellite navigation, but rather all other available data (time, image, other signals). WIMR can be used on Earth as an alternative to satellite navigation.
- **Docking Impender** – Impender is a novel solution for increased efficiency of mating orbital objects. It will find its application both in manned and unmanned vehicles, such as satellites requiring servicing or during removal of space debris. It is a project for ESA under the STARTIGER competition. The project is financed by ESA.
- **ReMY (Remote Mars Yard)** – a simulation of Martian rover exploration missions intended for adults, company teams, students and school groups. ReMY is also a robot placed on the Mars mock-up in Toruń, operated via the Internet by a group of participants from any location. The scenarios are based on the simulation of a space mission in which teamwork, communication, exchange of knowledge and division of roles are the key to success.

Laboratories, technical facilities, infrastructure

The company's facilities include structures for remote control of a mobile robot and an airbag table for 2D microgravity simulation. It also features a manipulator with adjustable resistance to movement. The company's accommodations additionally include electronic, mechanical and 3D printing facilities.

Other

The ReMY – Remote Mars Yard system infrastructure, a remote Martian rover simulator, will support entrepreneurs and research units conducting research to develop better control procedures for similar mobile devices, and the results of such research will increase the effectiveness of the broadly understood user interface. The service will be available beginning in 2019.



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Asseco Poland S.A.



Asseco Poland S.A. is the largest IT company in Poland traded on the Warsaw Stock Exchange (WSE), and the sixth largest in Europe. The main business areas of activity are in the financial and public sectors (central and local administration, healthcare, security sector), as well as services for the business sector (telecommunication, energy sector, utilities, fast-moving consumer goods (FMCG)).

Asseco Poland's space sector is managed by the International Organizations and Security Sector Solutions Department (PRW), whose space activities commenced in 2014. The current PRW space strategy is focused on continuous development of its competencies in the following technological domains: spacecraft flight management and control, surveillance and data analysis systems, and simulations and training systems.

Asseco Poland creates software for ESA and cooperates with European and national space entities. The company also actively supports national administration goals with its software for processing and analyzing of space data. Additionally, the company supports emerging space sector enterprises with its knowledge and experience.

General information

Type of entity: **large company**

Type of activity: **production**

Total employment: **2456**

(including **53** in PRW Department)

Number of engineers and scientists: **2032**

(including **50** in PRW Department)

Main areas of space activity

1. Telecommunication and Navigation (GNSS)
2. Utilization of Satellite Data, Satellite Databases
3. Space System Software: Ground Systems Software and On-Board Software



Examples of completed or on-going space-related activities

- **EGNOS–SDATS** (ESA) – a tool set for rapid extraction and data parsing received from information processing centres (CPFs) and ranging and integrity monitoring stations (RIMS). It is a Performance Qualification tool useful to enhance the quality of releases of the EGNOS to improve availability and accuracy of GPS signals, detect deviations, and report on key parameters.
- **EGNOS–SATE** (ESA) – is the development of the improved SDATS v2 set of tools to: address the obsolescence of EGNOS legacy tools, enhance EGNOS operator processes & communication to users, and shorten the “Observation Report” investigations cycle with a new troubleshooting process.
- **ESOC–SIMSAT Web HMI** (ESA) – a technology upgrade which allows access via web browser and development of the graphical interface to visualize the spacecraft during runtime, based on spacecraft architecture for simulation purposes. The SIMSAT Web-HMI interfacing component enables communication between the SIMSAT Kernel and web applications.
- **ESOC–EU4DMO** (ESA) – a light-weight, web-based client application for Monitoring and Control of cube-sat experiments. The application brings the capabilities of Mission Operation Services for Monitoring and Control of satellites to distributed users. The software is based on the CCSDS Mission Operations Framework.
- **EGNOS–DREAM (ESA)** – the DFMC Ready EGNOS Analysis Module. The aim of this project is to define the global unified interface (ICD) for tools, scripts, and simulation platforms employed by the Performance Team of the EGNOS Project Office, as well as to develop the converters to/from existing tools and to develop a generic plotting tool.

Laboratories, technical facilities, infrastructure

Asseco Poland maintains all necessary software tools and IT infrastructure to enable the development of products and services for space (e.g., CMMI-DEV Level 3, ISO and AQAP Quality Certificates, and Industrial and Personnel Security Clearance).

Other

Beyond the space sector, Asseco’s PRW Department provides its solutions and services in Situational Awareness (C4ISR) Unmanned Aerial Systems (UAS), Cyber Security, and Image Analysis. The PRW Department is expert in the integration of COTS solutions (Microsoft platforms, GIS – EXRI/ENVI/BAE, MSSQL, Oracle) and implementations of its own and open source solutions.



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Astri Polska Sp. z o.o.

ASTRI POLSKA

Astri Polska is the first Polish company with 100% of its revenues coming from space business activity. It specializes in electronics, optomechanics, GNSS, Earth observations, and satellite applications.

The company portfolio includes approximately 50 projects concerning development of space technologies for, e.g.: ESA, the European Commission (FP7, BONUS, ENIAC, Horizon 2020), and the Polish National Centre for Research and Development (NCBiR). It delivers solutions to leading European space programmes, such as JUICE, MetOp-SG, Sentinel-5, NeoSat, and EUCLID. Astri Polska is an authorized distributor of Airbus Defence and Space satellite imagery and geoinformation products. It also has the ability to develop applications based on EO data and has been appointed as a Copernicus Relay – an official partner of the Copernicus programme in Poland.

Astri Polska is a Joint Venture of Airbus Defence and Space and the Space Research Centre of Polish Academy of Sciences (CBK PAN). Since its foundation in 2010, the company has been growing rapidly, employing approximately 80 people, primarily Polish engineers. Astri Polska's activities are in line with the priorities of the Polish Space Strategy.

General information

Type of entity: **large company**

Type of activity: **production and services**

Total employment: **80**

Number of engineers and scientists: **70**

Main areas of space activity

1. Electronics
2. Others: Applications and Satellite Services (Earth Observation, testing of GNSS receivers, crisis management)
3. Optics and Optoelectronics



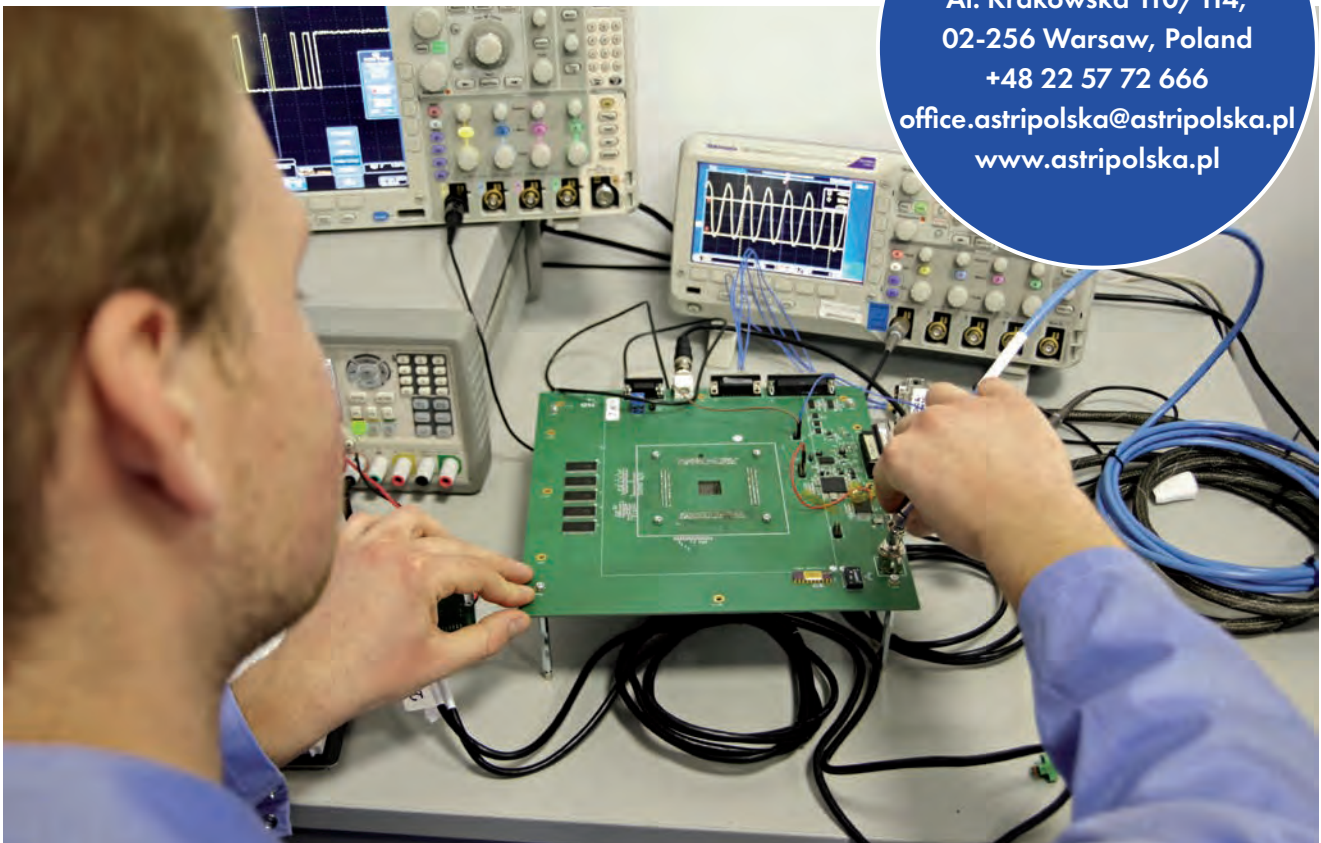
Examples of completed or on-going space-related activities

- **JUICE** – design and production of test equipment (EGSE) for electronic systems of the JUICE probe and digital simulation models. The project is carried out for ESA.
- **MetOp** – design and production of two types of electronic test equipment (EGSE), which are Simulation Front End and Simulated Electrical Flight Model for MetOp-SG (second generation) satellites. The project includes design and development of RF-Suitcases – validation equipment for ground stations responsible for communication with satellites. This project is carried out for ESA.
- **NeoSat** – design and production of the same two types of electronic test equipment (EGSE), *Simulation Front End and Simulated Electrical Flight Model* for Eurostar Neo, a new generation, European telecommunication satellite platform. The project is likewise carried out for ESA.
- **UV2VIS** – design and production of an optical system (OGSE) which will make it possible to test the main sensor of SENTINEL-5 mission, which will be a part of the Copernicus Earth observations programme.
- **AGGA-4** – design and production of the test environment for AGGA-4 – the integrated circuit of space-grade satellite GNSS receivers, including radiation test of the circuit. The project is carried out for ESA.

Laboratories, technical facilities, infrastructure

- electronic laboratory equipped with specialized apparatus for production and testing of electronic devices for the space sector;
- optical laboratory equipped with an optical top active vibration isolation system; and
- cleanroom (ISO 8 standard. Tent upgrading the standard to ISO 5).

Both facilities are equipped with detectors and dedicated mechanical and optical equipment.



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Astronika Sp. z o.o.



Astronika Sp. z o.o. was established in 2013 by a group of engineers hailing mainly from the Space Mechatronics and Robotics Laboratory of CBK PAN, where they were responsible for the development of space mechanisms and project coordination. Astronika's main field of operation is the design, manufacturing, integration and testing of mechanical systems. To ensure its capability of handling the full life cycle of the project, Astronika constantly expands its manufacturing, laboratory and testing infrastructure, all the while maintaining an extensive network of suppliers that guarantee the highest standards of performance.

Astronika's key products and services include:

- penetrators and ground sampling devices equipped with unique electromagnetic drives;
- hold down & release mechanisms characterized by non-explosive pyrotechnic elements, low levels of generated vibrations, the potential for reusability, high reliability, as well as light and compact construction;
- mechanisms based on tubular tape technology, most notably: antenna systems, booms for small sensors, and ultra-light planetary manipulators; and
- consulting services in the fields of space mechanisms design and testing, tribology, product quality engineering and designing bespoke mechanisms (including R&D).

General information

Type of entity: **SME**

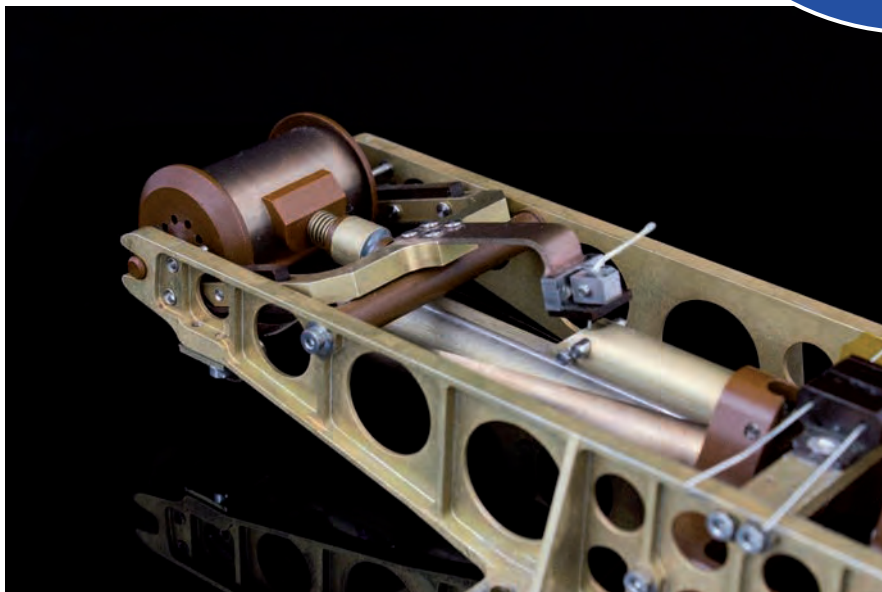
Type of activity: **production, services and research**

Total employment: **32**

Number of engineers and scientists: **26**

Main areas of space activity

1. **Mechanics**
2. **Automation & Robotics, Space Systems Control**
3. **Structures**



Examples of completed or on-going space-related activities

- **“HDRM for the EUROSTAR 3000 Deployable Reflector Assembly”** – the project comprises the development of a Hold Down and Release Mechanism for solar arrays; a project carried out in cooperation with AIRBUS Defence and Space.
- **„Hammering Mechanism for HP3 Penetrator”** – a project commissioned by the German Space Agency (DLR), developed for NASA’s InSight Mars mission.
- **„JUICE RPWI LP-PWI and RWI”** – a project realized for ESA, which encompasses the analysis, manufacturing, integration and tests of two instruments for the JUICE mission: deployers for a Langmuir probe and radio wave antennas.
- **“BoomCoat”** – the main objective of this project is to develop and test the surface modifications (PVD coating and surface finish) of metallic tapes used for tubular boom applications in space instruments and mechanisms.
- **„RadMag Instrument Implementation for RADCUBE IOD Mission”** – a project for the Hungarian company C3S, which comprises the provision of a tubular boom for a science probe.

Laboratories, technical facilities, infrastructure

Astronika is constantly expanding its technical facilities. At present, the company has the necessary infrastructure for rapid prototyping (including 3D printers of various types) and for integration and testing (laminar flow cabinet and a TVAC chamber).



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Blue Dot Solutions Sp. z o.o.



Blue Dot Solutions Sp. z o.o. is a company founded by graduates of Polish and foreign universities, who possess various experience in conducting space industry projects. Currently, the company is offering technological expertise services, as well as product definition of services utilizing satellite data and providing information services related to the space sector.

The company is working on internal projects using GNSS, Earth Observation, integrated applications, modern materials and mechanics. The Blue Dot Solutions team has a broad contact network in over 50 countries, including the International Space University network. The company's results are regularly presented and published, including at International Astronautical Congresses (IACs).

Competences:

- consulting activities in dedicated areas (development niches);
- partnership activities in ESA, the EC, and other projects;
- partnership activities in projects related to materials and mechanics in space technology use;
- partnership in integrated application projects utilizing satellite assets;
- technological expertise and requirements definition in projects related to communication, data management, data reading and processing; and
- use of new technological solutions in satellite navigation.

General information

Type of entity: **SME**

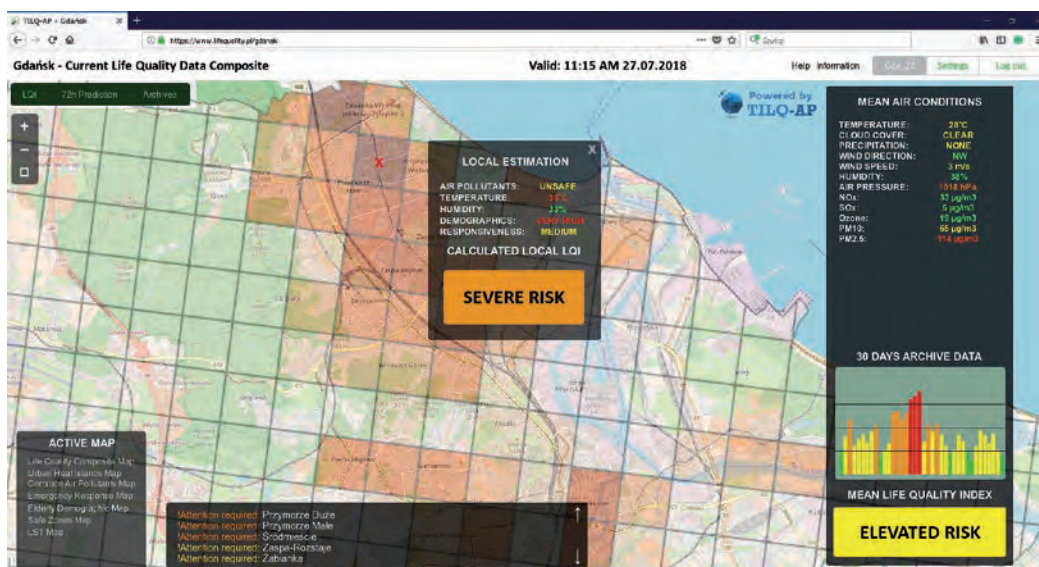
Type of activity: **production, services and research**

Total employment: **12**

Number of engineers and scientists: **9**

Main areas of space activity

1. Utilization of Satellite Data, Satellite Databases
2. Telecommunication and Navigation (GNSS)
3. Material Engineering



Examples of completed or on-going space-related activities

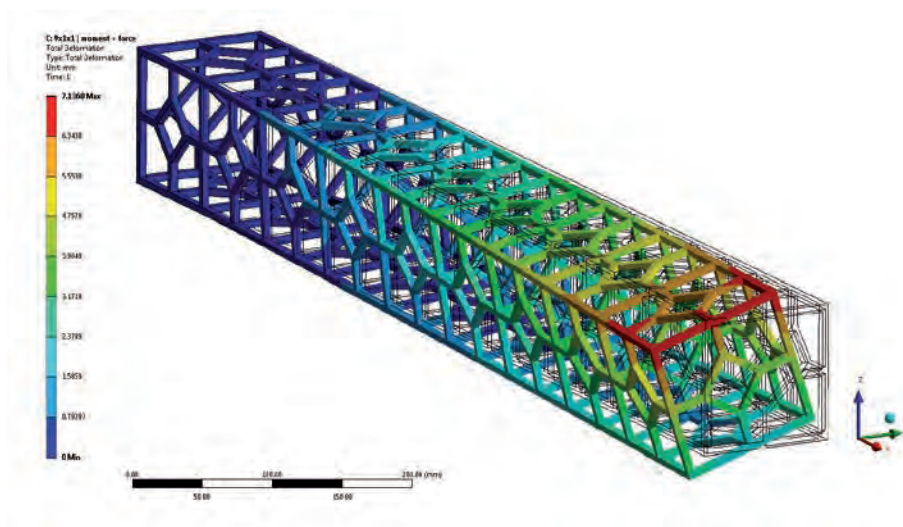
- **HATCH** (Horizon 2020 Programme, European Commission, www.spacehatch.eu) – a scalable, interactive and user-friendly platform-tool listing European space projects and related services.
- **FLAMINGO** (Horizon 2020 Programme, European Commission) – a project to increase positioning precision with Galileo Initial Services in city environments utilizing many typical devices available on the market. The system demonstration will take place in Gdansk.
- **GroundEye** – management system for moving devices supporting airports (navigation + IoT).
- Designing a multifunctional harness for space and aviation electronics with special attention to power electronics.
- **Space3ac** – accelerator program supporting entities with products utilizing telecommunications and satellite data.

Laboratories, technical facilities, infrastructure

The company maintains its own computing lab (EAGLE, Matlab+Signal Processing Toolbox, Ansys Pro, Solid Edge) at the Olivia Business Centre in Gdansk. In a dedicated lab, the following equipment is featured: 3D printers, soldering stations, measuring instruments, microscopes and oscilloscopes.

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CloudFerro Sp. z o.o.



CloudFerro (CF) is a Polish technological company established at the beginning of 2015 by a group of experienced executives of IT and telecom businesses. CloudFerro provides its customers with dedicated servers, private and public computing clouds and virtual data centres with full administrative capabilities. The CloudFerro solutions are based on OpenStack – an open source cloud system. CloudFerro is the only company in Poland to integrate services of bare metal and virtual servers.

The company specializes in storage and processing Big Data, including satellite data. CloudFerro's cloud computing system provides extensive API, which enables full integration with the customer's platforms. As part of EO Cloud (<https://eocloud.cloudferro.com>) and EO DIAS (www.eodias.eu), the company supports multi-petabytes data sets from Copernicus system satellites together with additional tools, such as: satellite products search engine (<https://finder.eocloud.eu>); or satellite pictures search engine (<https://apps.eocloud.sentinel-hub.com/eo-browser/>).

The company employs an experienced team of engineers and programmers specializing in cloud computing, design, implementation and management of advanced IT systems.

General information

Type of entity: **SME**

Type of activity: **services**

Total employment: **30**

Number of engineers and scientists: **20**

Main areas of space activity

1. **Others: IT services: Cloud computing and storage for satellite data**
2. **Utilization of Satellite Data, Satellite Databases**



Examples of completed or on-going space-related activities

- **Project: „EO INNOVATION PLATFORM TESTBED POLAND” (ESA)** – CloudFerro has built and currently manages an EO Cloud platform (eocloud.cloudferro.com).
- **Hybrid cloud services (CDS Hybrid Cloud) for climate data storage (ECMWF)** – CloudFerro provides a hybrid cloud solution - CDS Hybrid Cloud. The Hybrid Cloud consists of a private cloud based in the customer's location in Reading, UK, and accessible to the public cloud EO Cloud, belonging to CloudFerro and located in Warsaw.
- **Project “EO DIAS” (ESA)**, European cloud computing platform for Earth observation satellite data processing – CloudFerro is a supplier and operator of the cloud in the consortium, which was selected for the supply of Data Integration and Analysis System (DIAS) for the Copernicus project data. The solution will provide a comprehensive data processing platform for Copernicus data users from all over Europe. As a result, all Sentinel-1, Sentinel-2, Sentinel-3, ESA/Landsat and other mission data will be available immediately to users.

Laboratories, technical facilities, infrastructure

Cloud computing infrastructure with over 5000 vCores, about 20 TB RAM, about 12 PB of different types storage, available in the realms of both public and private clouds.

Earth observation satellite data available from the public cloud mentioned above includes data from Sentinel-1, Sentinel-2, Sentinel-3, ESA/Landsat, Envisat/Meris.



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Creotech Instruments S.A.



Creotech Instruments is active in three main domains: electronics development and production; microsatellite integration; and EO data hosting and processing. The company develops and manufactures electronics for space, industrial and scientific applications, e.g., satellite and ground segment electronics subsystems; scientific sub-nanosecond time synchronization systems; advanced CCD/CMOS cameras, embedded computers and other specialized control & measurement systems; and intelligent power suppliers. Products developed and/or manufactured by Creotech are used by ESA and leading scientific centers, including: CERN, GSI, DESY, IKHEF, ITER, DARPA, and others.

General information

Type of entity: **SME**

Type of activity: **production, services and research**

Total employment: **70**

Number of engineers and scientists: **50**

Main areas of space activity

1. Electronics
2. Utilization of Satellite Data, Satellite Databases
3. Others: MAIT
(Manufacturing, Assembly, Integration and Test)



Examples of completed or on-going space-related activities

- **PSU for MXGS ASIM on ISS (in-orbit)** – the ASIM project is historically the first space order for the company. The goal of the project was to assemble a power supply unit (PSU). The PSU is one of the existing two instruments, known as ASIM-MXGS. Its main task is to collect data on radiation flares invisible to the human eye.
- **PSU for CaSSIS ExoMars (in Mars orbit)** – Creotech Instruments, together with the Space Research Center of the Polish Academy of Sciences, produced and installed an advanced CaSSiS camera, through which scientists can search for traces of life on Mars. The project was carried out as part of the ExoMars space mission, which is jointly organized by ESA and the Space Agency of the Russian Federation (Roscosmos).
- **WhiteRabbit study** – a feasibility study for ESA and ESOC. The main goal of the WR-SYNTEF project was to prepare a feasibility study of the White Rabbit (WR) technology application for time synchronization and frequency distribution between ESA ground stations. WR can be used in the most time critical parts of ground stations where time synchronisation must be more precise than in the networks which use NTP or PTP.
- **MAIT qualification project** – the main project activity is a full certification and relevant documentation dossier for the MAIT (Manufacturing, Assembly, Integration and Test) at Creotech and the qualification/acceptance reports for the PFM models of flight electronics for the Projects. The project will have a decisive impact on Creotech's ability to perform the flight electronics MAIT and further develop PA/QA and industrial processes.
- **C-DIAS Platform** – as envisioned, the infrastructure being built will be one of the four competing centers emerging as part of the Copernicus Data and Information Access Service (C-DIAS) project. Each of them has not only to store all current and historical data collected as part of the Copernicus program, but also to offer users access to computing power in the cloud structure.

Laboratories, technical facilities, infrastructure

Creotech facilities include: 3 cleanrooms of total about 200 m²; a specialized automatic assembly line; and other manufacturing and testing equipment, including a climatic chamber and automatic electronics quality system.

Other

Creotech has been qualified by ESA for assembly of space electronics. It is also certified according to ISO 9001:2009, ISO 13485:2012, IPC J-STD-001, IPC 610.

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GMV Innovating Solutions Sp. z o.o.



GMV Innovating Solutions Sp. z o.o. was founded in 2009 as a fully owned subsidiary in Poland of the international technology group GMV. The company is an IT solutions provider and develops in Poland GMV's complete portfolio of activities. It also performs its own projects with a particular focus on three industries: Space; Intelligent Transportation Systems (ITS); and defense and security. The global aim of GMV Innovating Solutions Sp. z o.o. activities is to provide solutions, integrated systems, and specialized hi-tech products and services in close cooperation with its clients.

Within the space sector, principal clients of GMV Poland include entities of the European Space Agency (ESTEC/ESOC/ESRIN). A Polish team of engineers supports ESA missions by development of dedicated software tools, including both downstream and upstream applications. GMV Poland also cooperates with large European space sector companies by providing them support and software tools within ESA, EU, and EUMETSAT programs.

GMV Poland is additionally a provider of localization systems, fleet management, and intelligent transportation systems based on satellite data and GNSS. GMV Innovating Solutions has offices in Warsaw (main office) and in Szczecin.

General information

Type of entity: **large company**

Type of activity: **production, services and research**

Total employment: **86**

Number of engineers and scientists: **75**

Main areas of space activity

1. **Space System Software: Ground Systems Software and On-Board Software**
2. **Utilization of Satellite Data, Satellite Databases**
3. **Automation & Robotics, Space Systems Control**



Examples of completed or on-going space-related activities

- **GNSS SW Receiver for Space applications – Multicore Application SW on Next Generation Multi-core Processor** – development of the software defined GNSS receiver for space applications, dedicated for small and medium satellites and micro-launchers.
- **Mission Analysis for BIOMASS B2/C/D/E1** – GMV Poland is responsible for full mission analysis along all mission phases.
- **EarthCARE Level-0, Orbit and Attitude Processor and Aeolus/EarthCARE Browse Processors Developments** – definition, design, implementation and maintenance of a LO processor for EarthCARE mission.
- **OPS-SAT Phase B2/C/D/E1 – ADCS (Attitude Determination and Control System) design and implementation, FDIR, MOS implementation** – full on-board software and ADCS (Attitude Determination and Control System) design and implementation, as well as Implementation of Mission Operation Services standards and POCKET+.
- **Development of the Ground Processor Prototype (GPP) and Instrument Data Simulator (IDS) of the SCA Instrument of MetOp-SG.**

Laboratories, technical facilities, infrastructure

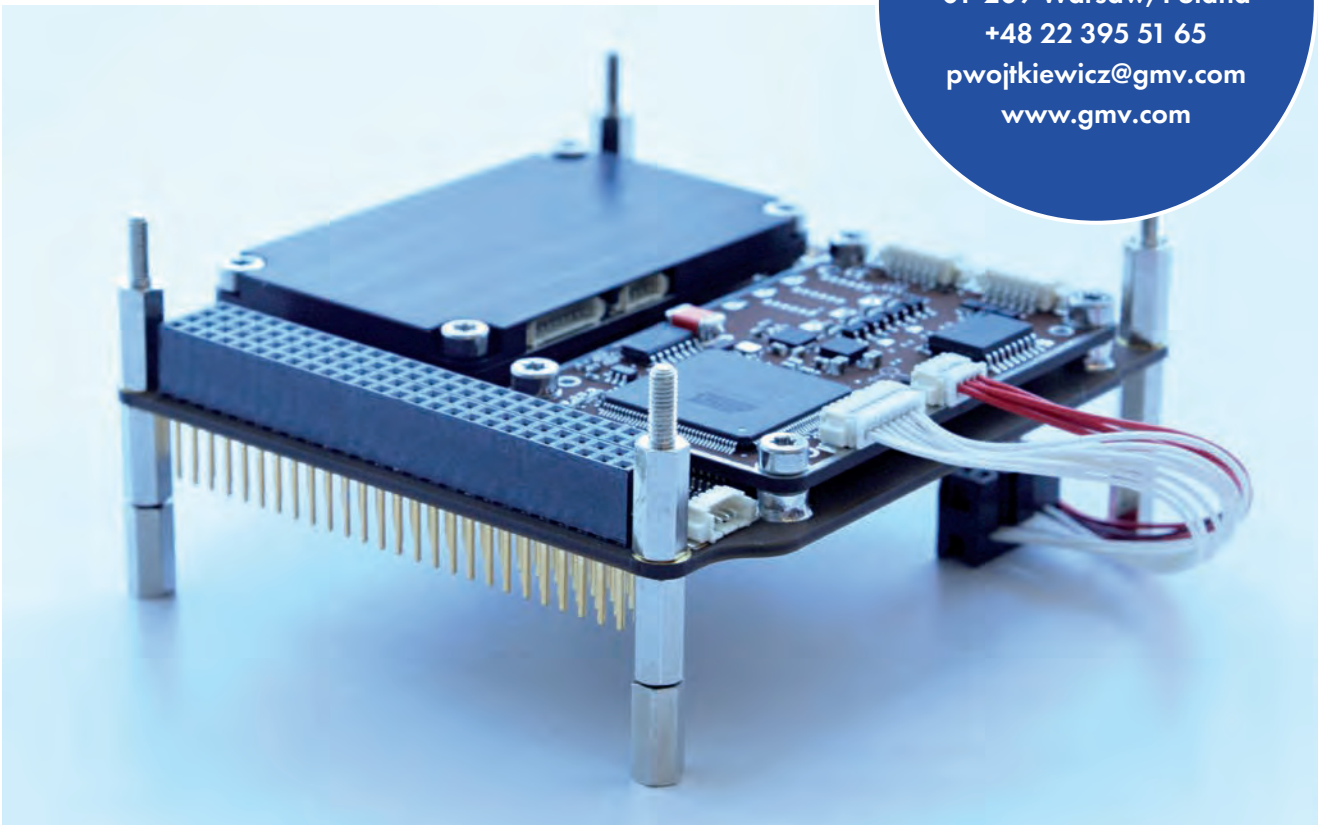
GMV possesses all necessary software tools and IT infrastructure to enable the development of products and services for space, transportation, and security & defence sectors.

Other

- CMMI Level 5 certificate;
- Security Clearance: UE and National Secret Clearance Certificate for Enterprise;
- Implemented Quality Assurance policy.

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Hertz Systems Ltd Sp. z o.o.



Hertz Systems has 30 years of experience in the field of modern, effective security solutions. It specializes in satellite navigation, space systems, security, and data exchange systems.

Hertz Systems executes space projects related to, among others, GNSS systems for downstream, time & frequency synchronization, and sensors for upstream use. The company contributes to the development of the European satellite navigation system through its work on Galileo PRS technology and on the test environment for Galileo. It also provides testing and validation services for satellite modules.

Hertz Systems is additionally active in the military market, featuring its key product – a GPS receiver integrated with an SAASM cryptographic module, and developing new systems, including a GPS enhanced with inertial navigation, with applications for military drones.

The company also specializes in systems to ensure the safety of critical infrastructure (Hawk system for detection and neutralization of drones) and critical data (TEMPEST equipment).

General information

Type of entity: **SME**

Type of activity: **production, services and research**

Total employment: **200**

Number of engineers and scientists: **40**

Main areas of space activity

1. Telecommunication and Navigation (GNSS)
2. Electronics
3. Space System Software: Ground Systems Software and On-Board Software



Examples of completed or on-going space-related activities

- **“Integrated 3D Sensors”** (Horizon 2020 Programme, European Commission) – development of a radar sensor for orbital applications.
- **„Galileo 2nd Generation Direct L-band signal generation”** (EGEP Programme, ESA) – development of a test environment for the Galileo signal generator.
- **“Remotely disciplined frequency and time standard module”** (ESA) – designing the architecture of a time and frequency synchronization module.
- **“Enhanced RPAS Automation”** project for the European Defense Agency – design of a GNSS module enhanced with inertial navigation.
- **GPS-SAASM/GALILEO-PRS** – development of cryptographic satellite navigation receiver dedicated for use by governmental authorities. The project is co-financed by the European Union under the Regional Operational Program.

Laboratories, technical facilities, infrastructure

- Electromagnetic Compatibility Laboratory
- Acoustic and Electro-Acoustic Laboratory
- Spectrum analyser MS2711E
- Digital oscilloscopes (MDO3104, DS 1204B)
- GNSS signals simulator (Spectracom)
- HDL simulator (Icarus)
- CAD/CAE systems (Xilinx, Intel (Altera))
- Matlab

The company has also a certified Cryptographic Chancellery and Secret Office.

Other

Hertz Systems is a highly-trusted partner, as demonstrated by its certificates, concessions, and implemented quality systems (ISO 9001:2008, AQAP 2110: 2016, AQAP 2210:2015). The company has Industrial Security Certificates with ESA SE-CRET, EU SECRET, and NATO SECRET clauses.



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InPhoTech Sp. z o.o.



InPhoTech is a company with experience in research, development, and production of innovative fibre optic solutions applicable in many industries, including telecommunications, metrology, quality analysis, space, transportation, and security.

InPhoTech carries out modelling, fabrication, research, and development of special optical fibres, innovative optical fibre components, and photonic devices.

For the space industry, the company offers:

- passive and active optical fibres, resistant to cosmic radiation, for data transmission between devices;
- active multi-core optical fibres for fibre optic amplifiers;
- optical fibres operating in high temperatures and highly acidic/alkaline environments;
- fibre optic measuring sensors (temperature, strain, pressure, vibration) adapted to work in demanding space conditions;
- passive multicore optical fibres for sensing (e.g., shape sensors);
- integration technology for use in optical fibres with composite and metal materials; and
- splicing technology for optical fibres and precise post-processing of glass elements.

General information

Type of entity: **SME**

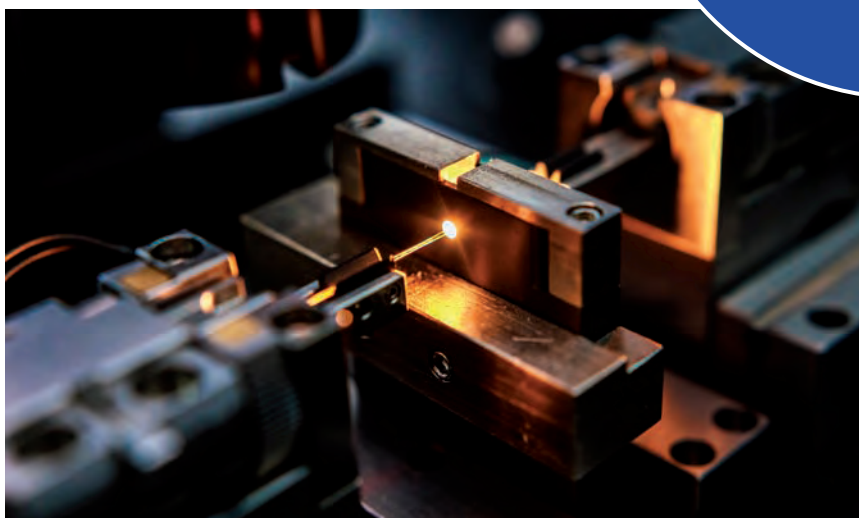
Type of activity: **production, services and research**

Total employment: **52**

Number of engineers and scientists: **29**

Main areas of space activity

1. Others: Photonics
2. Optics and Optoelectronics



As a part of the InPhoTech group, spin-off companies were also established to implement specific solutions dedicated to industries such as medicine, mining, and oil & gas production.

Examples of completed or on-going space-related activities

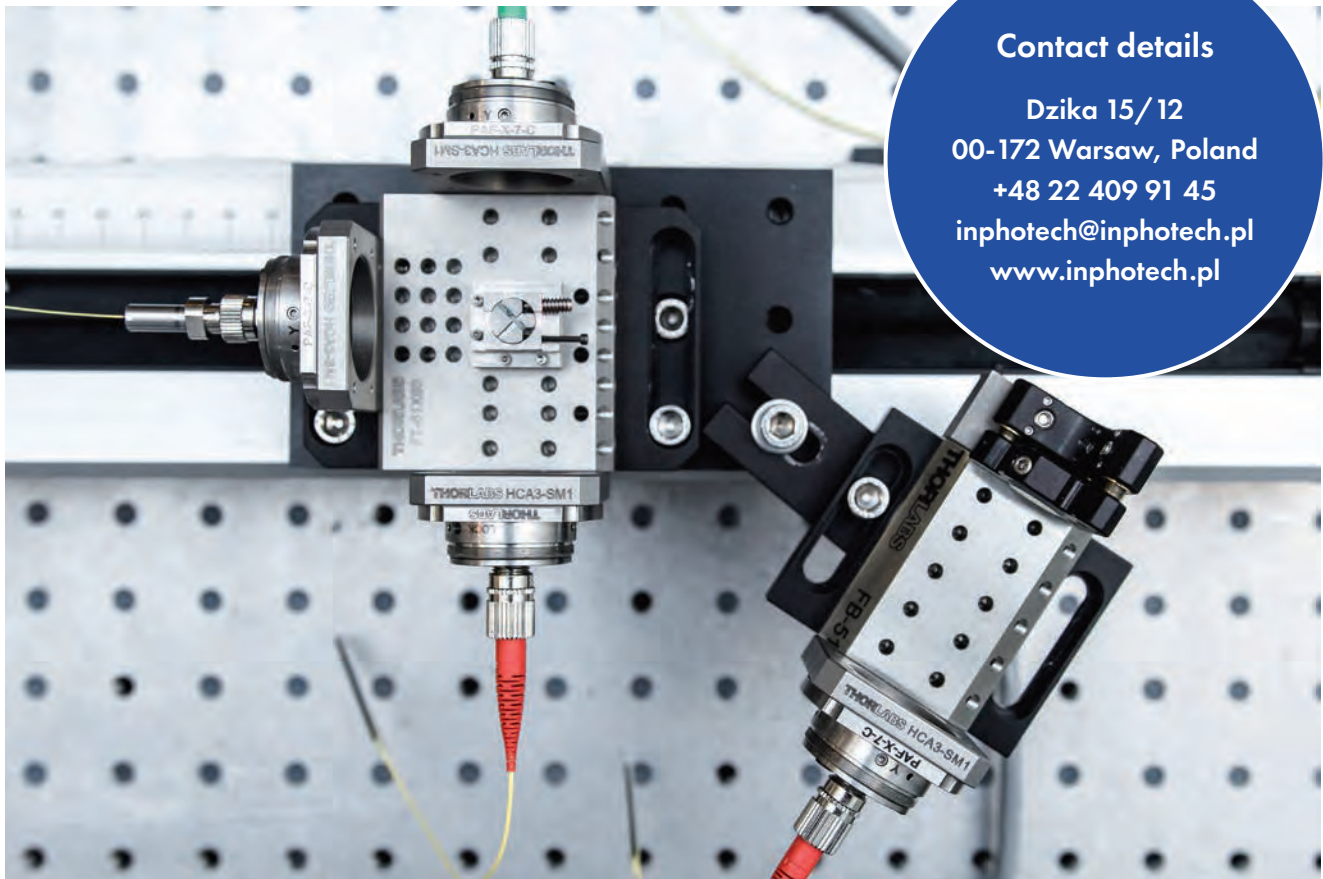
- **FINESSE** – optical fibres integrated in composite materials.
- **BEACON** – scalable & low-power microwave photonics for flexible, terabit telecom payloads & high speed coherent inter-satellite links.
- **NODUS** – new optical fibres dedicated to distributed sensors in nuclear environments.
- **OVERSCAN** – an optical fibre vibration and deformation sensor based on multicore optical fibre and VCSEL array technologies.

Laboratories, technical facilities, infrastructure

InPhoTech boasts an optical measurements laboratory of photonic devices, a laboratory for measurements in environments simulating real conditions (temperature, humidity, dust, pressure, stresses, concentration of gases, vibrations), a laboratory for micromachining and thermomechanical splicing of glass elements, a Fibre Bragg Grating laboratory, a laboratory for acquisition and analysis of measured data, a prototypes manufacturing facility, a chemical laboratory, and an electronic laboratory.

Other

InPhoTech is a member of the Cluster for Photonics and Fibre Optic associating companies, scientific and research units, and business environment institutions whose aim is cooperation in the field of photonics. Owing to cooperation within the Cluster, InPhotech has access to specialized infrastructure, including for the production of optical fibres, scanning electron microscopes, photonic structures, facilities for numerical analysis, and an optical fibers design laboratory.



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ITTI Sp. z o.o.



ITTI Sp. z o.o. is an IT company offering services and solutions to companies and institutions in Poland and abroad since 1996. The company headquarters is located in Poznan. The main goal of the company is to develop innovative applications and customized software solutions. For many years, ITTI has also been involved in R&D projects in international programmes, e.g., the European Commission's H2020 framework program and programmes of the European Defence Agency (EDA). ITTI also provides services to the European Network and Information Security Agency (ENISA).

In 2013, the company began work for the European Space Agency (ESA). In the space sector, ITTI focuses on development of software solutions in the following areas: Space Situational Awareness, Support to AIT (Assembly Integration and Testing) activities during mission preparation, and protocols for on-board communication (e.g., SpaceWire). Among ITTI's many partners are universities, research institutes, and small, medium and large companies from numerous European countries.

General information

Type of entity: **SME**

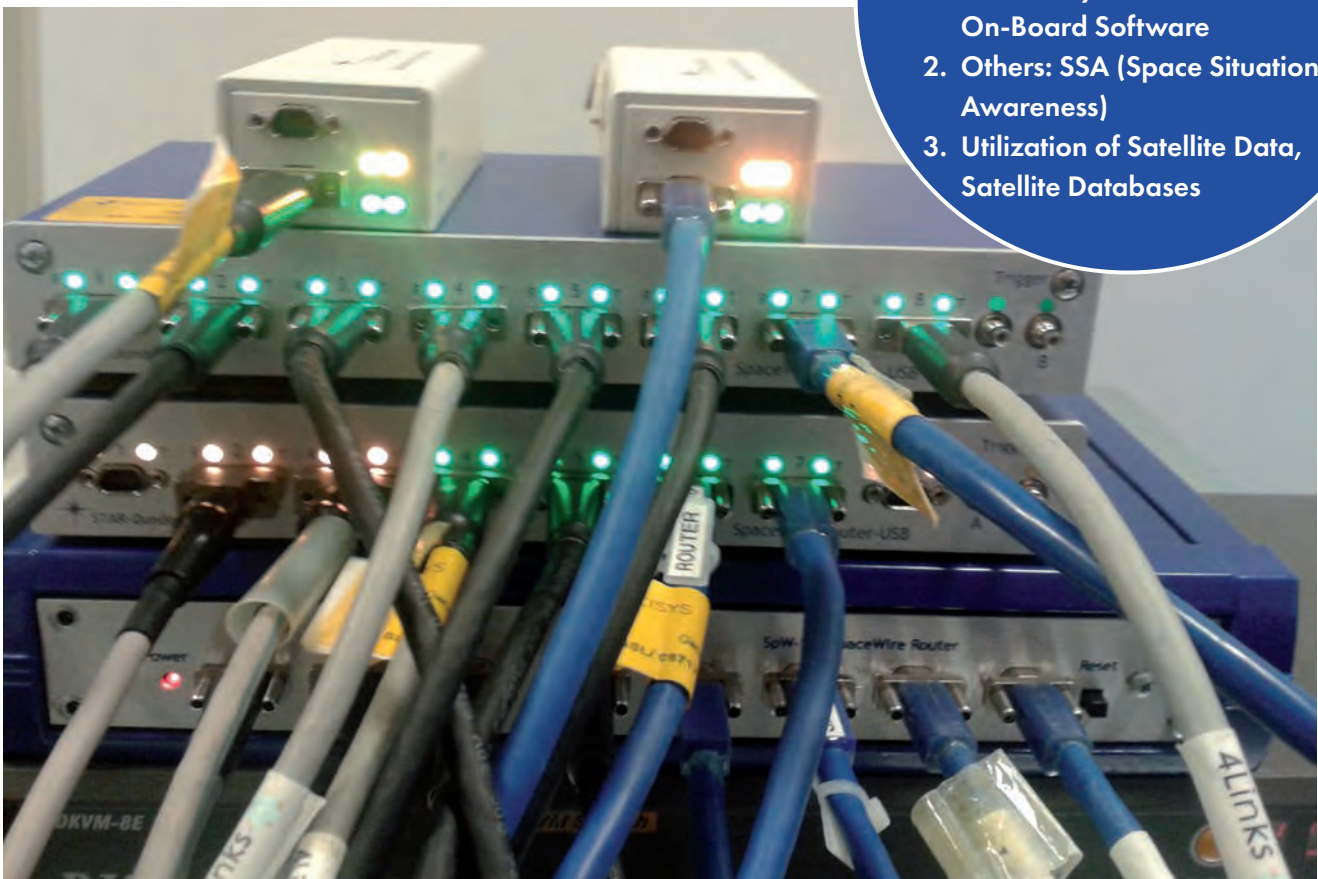
Type of activity: **services**

Total employment: **ca. 50**

Number of engineers and scientists: **ca. 40**

Main areas of space activity

1. Space System Software: Ground Systems Software and On-Board Software
2. Others: SSA (Space Situational Awareness)
3. Utilization of Satellite Data, Satellite Databases



Examples of completed or on-going space-related activities

- **P2-NEO-VI NEO User Support Tools** – the proposed solution for this endeavor was the NEO Support Toolkit to help in NEO research, e.g., to plan observations and track movement of target bodies. The Toolkit was implemented in the form of the web service and can be accessed using standard web browsers. The User Interface follows the User Centered Design (UCD) concept and is compatible with ESA style guidelines.
- **Polish component to SSA** (feasibility study) – the main objective of the feasibility study was to gather information on the existing infrastructure and capabilities of Poland within three areas of the Space Situational Awareness (SSA) programme. The roadmap for the future SSA infrastructure in Poland was one of the principal results of the project.
- **ATENA (Adjusting open Test Exchange staNdard to the spAce domain)** – the goal of the ATENA project was to adjust the OTX standard (Open Test sequence eXchange format) to the requirements of the space domain (ECSS-E-70 standards), and to implement a set of tools that support a user in the process of building and executing test sequences on space systems, namely the ATENA OTX Engine and ATENA OTX Editor.
- **INSPECTOR** – the aim of the INSPECTOR project was to create a prototype of a knowledge management system which would enable engineers to extract desired information from legacy data sets in significantly faster and more convenient ways than presently exist during AIT/AIV processes, as well as during operations related to space systems and subsystems.
- **SPACEMAN** – the SPACEMAN project was focused upon the design and development of a software tool for managing networks based on SpaceWire (SpW) used for on-board communications. The functionality of the SPACEMAN tool includes: Automatic SpW network topology detection, SpW network configuration, SpW network comparison, Live visualization of SpW network changes, Network model editing, XML representation of SpW networks, and Packet-level testing.

Laboratories, technical facilities, infrastructure

ITTI operates the following tools, which can be applied in laboratories and testing benches:

- ATENA – toolkit for designing and execution of functional tests of satellite systems. It uses the OTX that is widely used among others in the automotive industry.
- SPACEMAN tool – a tool for managing SpaceWire networks which are used in on-board communication in satellites.
- IT infrastructure for carrying out IT projects.

Other

ITTI employees hold the following certificates: KPRINCE2 Certificate Foundation (Projects IN Controlled Environments), ITIL Foundation Certificate (IT Service Management Best Practices), ITIL Service Manager Certificate, Lead Auditor Certificate ISO 27001, TOGAF (Enterprise Architecture). ITTI representatives additionally participate in training on ECSS standards and on engineering and management of SSTL satellite systems.

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Jakusz SpaceTech Sp. z o.o.



Jakusz SpaceTech was established in 2015 to develop space applications with a focus on propellants, rocket technologies, and research and development projects. The company is a derivative of Jakusz Sp. z o.o. (specializing in protection against explosions, munitions disposal, chambers for the safe transportation of explosives, and EMC protection), which was founded in 1985. Both companies belong to the SME space sector.

The main activities of Jakusz SpaceTech are:

- Production of 98% Hydrogen Peroxide (HTP) MIL-16005PRF;
- Production of HTPB;
- Mechanical Ground Support Equipment;
- Chemical engineering; and
- Research Services (physico-chem, metallurgy, polymers).

The company also provides training services for handling Hydrogen Peroxide, which training was performed for ESA, for example. Jakusz SpaceTech is additionally cooperating with partners in propulsion technologies, such as: rocket engines, propellants, fuel cells, chemical engineering (oxygen extraction from lunar regolith), neutralization of process gases, and underwater drones.

General information

Type of entity: **SME**

Type of activity: **production, services and research**

Total employment: **3**

Number of engineers and scientists: **3**

Main areas of space activity

1. Power Systems and Propulsion
2. Material Engineering
3. Mechanics



Examples of completed or on-going space-related activities

Currently, the company participates in the following projects as a prime contractor:

- **“SME Instrument”** (Horizon 2020 Programme, European Commission) – design of mobile container-based platform for manufacturing Hydrogen Peroxide.
Subcontractors: 2 entities.
- **“High Concentration Hydrogen Peroxide Safety Validation Testing”** (ESA) – production technology validation according to MIL-16005PRF standards. Homologation of packings for transportation.
Subcontractors: 4 entities.
- **“Hydrogen Peroxide Storability/Compatibility Verification”** (ESA) – physico-chem tests of Hydrogen Peroxide. Research demonstration to determine the compatibility of HTP with specific materials (polymers and metals).
Subcontractors: 11 entities.
- **“Optimization of passivation parameters for different aluminium alloys”** (ESA) – creation of procedure for fabricating protective layers on aluminium alloys, to protect against corrosive substances.
Subcontractors: 3 entities.

Laboratories, technical facilities, infrastructure

On the company's premises, there are production and research facilities, as well as a skilled design team. Among its facilities there is a chemical laboratory equipped with highly-sensitive balances, driers, water purification system, water baths, electric heaters, and a fume hood. The company also has testing equipment available, such as an automatic titrator, ph-meter, conductometer, viscometer, and densitometer. The laboratory is equipped with a ventilation/air filtration system to assure a clean environment, free of solid particles and outside contamination.

Other

Jakusz SpaceTech is available to join in innovative projects in any role (prime, subcontractor, consultant, supplier). The company is interested in development of new products and services with other partners and commercializing them on the market.

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KP Labs Sp. z o.o.



KP Labs was founded in 2016 by a group of engineers associated with the Silesian University of Technology who saw the potential of combining their scientific passions and business acumen. KP Labs' mission is to accelerate space exploration by advancing autonomous spacecraft operation and robotic technology.

The company's activity is focused on the production of advanced IT solutions in the field of computer vision, machine learning, and flight software. The methodical and innovative approach that has worked well in previous research projects translates into the highest quality of software provided to clients. KP Labs also provides services in the field of algorithm analysis and processing of satellite images and software development for satellite components and instruments.

General information

Type of entity: **SME**

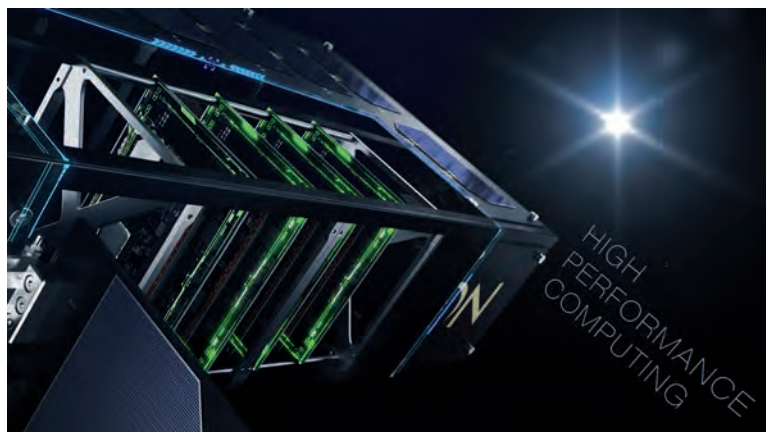
Type of activity: **Production, Services and Research**

Total employment: **26**

Number of engineers and scientists: **24**

Main areas of space activity

1. Space System Software: Ground Systems Software and On-Board Software
2. Utilization of Satellite Data, Satellite Databases
3. Optics and Optoelectronics



Examples of completed or on-going space-related activities

- **A microsatellite mission of Intuition-1** – the purpose of the Intuition-1 space mission is to observe the Earth using a satellite equipped with a hyperspectral instrument and advanced data processing on-board, using deep convolutional neural networks. It will be the first satellite in the world with a processing capacity that makes it possible to segment hyperspectral images in-orbit. This R&D project is co-funded by NCBR.
- **HYPERNET** (ESA) – this R&D project covers the analysis of hyperspectral images using neural networks. It involves the development and testing of algorithms for image segmentation, e.g., in agriculture, forestry, urban space, etc.
- **PW-Sat2 Satellite** – an educational project run by the Warsaw University of Technology with KP Labs as part of the project team. It aims to build a CubeSat 2U artificial satellite, which will test the innovative deorbiting system in the form of a 4m² sail, and checking the system of deployable solar arrays, the Sun sensor, and the electrical power system. KP Labs supports the construction of the satellite, providing software and hardware solutions. FP Space consortium funded the on-board computer, advancing the project to the next phase.

Other

KP Labsa is a member of the FP Space consortium, consisting of three Silesian enterprises: Future Processing, FP Instruments, and KP Labs. The objective is to support the space industry by providing quality software and hardware development services.

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Mobica Limited Sp. z o.o. oddział w Polsce



Mobica is a software services company offering bespoke development, quality assurance, and consultancy. Mobica specializes in complex, next generation, time critical projects across a wide range of industries for many of the world's leading companies (Google, Facebook, Amazon, Intel, ARM, Nvidia, Samsung, TomTom). It is largely focused on embedded, automotive, and mobile SW development.

General information

Type of entity: **large company**

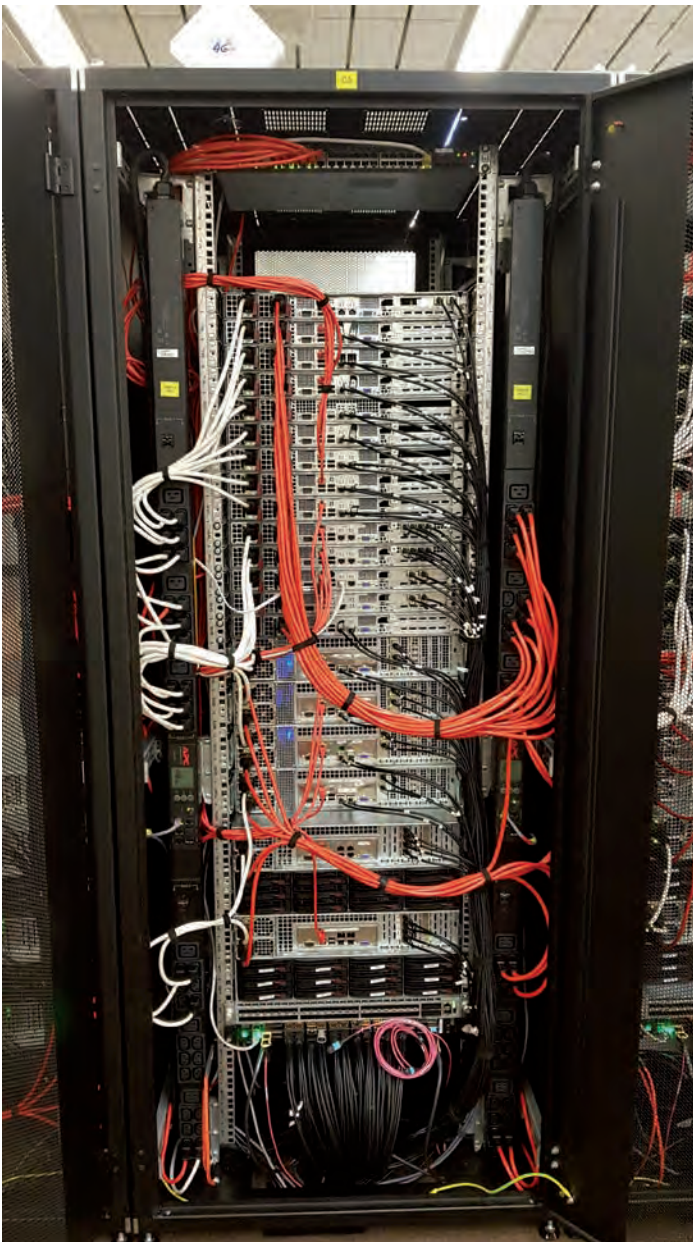
Type of activity: **services and research**

Total employment: **850**

Number of engineers and scientists: **730**

Main areas of space activity

1. Space System Software: Ground Systems Software and On-Board Software
2. Utilization of Satellite Data, Satellite Databases
3. Telecommunication and Navigation (GNSS)



Examples of completed or on-going space-related activities

- **MetOP CSW** – development of onboard SW managing devices for the MetOP SG satellite (Star Tracker, Solar Array, Transponder, etc). Integration and validation of the produced SW.
- **JUICE CSW** – development of onboard SW to manage devices of the JUICE probe (SpaceWire Router, Transponder, PCPU, etc). Integration and validation of the SW. Development of SW requirement specifications in cooperation with Airbus DS.
- **EO data processing** – development of a system to monitor the well-being of forests, based on Sentinel-1 and Sentinel-2 data. Work on increasing the resolution of EO MSI data.
- Work on a stratospheric platform (balloon-based) to enhance EO data, with geo-stationary capabilities. The platform will enable monitoring of a chosen area in the visual and IR ranges.
- Processing drone imaging data into 3D terrain models.

Laboratories, technical facilities, infrastructure

- SW development offices: Warsaw, Łódź, Bydgoszcz, Szczecin, Rzeszów, Lublin, Poznań, Wrocław;
- various SDKs for SW development (many embedded platforms), also for critical SW:
 - compilers,
 - design tools (Visual Paradigm, Papyrus, TopCased, etc.),
 - static analysis tools (lint, clockwork, Logiscope),
 - dynamic analysis tools (VectorCast, gcov/lcov, SonarCube);
- configuration management and continuous integration tools (Jenkins, git, gerrit, etc.);
- embedded systems support: breadboards, JTAGs, interfaces, etc.; and
- DJI Inspire drone.

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N7 Space Sp. z o.o.



N7 Space is a joint venture software company of Spacebel (Belgium) and N7 Mobile (Poland). The company's engineering team has acquired a high level of qualification thanks to the practical experience accumulated by carrying out various on-board software projects dating back to 2014.

The company mission is to provide cutting-edge software solutions for the space industry with a focus on critical embedded systems and EO data applications. With the strong support of SPACEBEL's 30 years of experience in the space industry and N7 Mobile's 10 years of mobile and backend systems software development, the company provides high quality software development services in the following domains:

- on-board software (Leon3, ARM);
- EGSE & SVF software;
- ASN.1/ACN modelling;
- test scripting engines;
- database software;
- ground segment software; and
- services and applications based on EO data.

General information

Type of entity: **SME**

Type of activity: **production, services and research**

Total employment: **10**

Number of engineers and scientists: **10**

Main areas of space activity

1. Space System Software: Ground Systems Software and On-Board Software
2. Utilization of Satellite Data, Satellite Databases

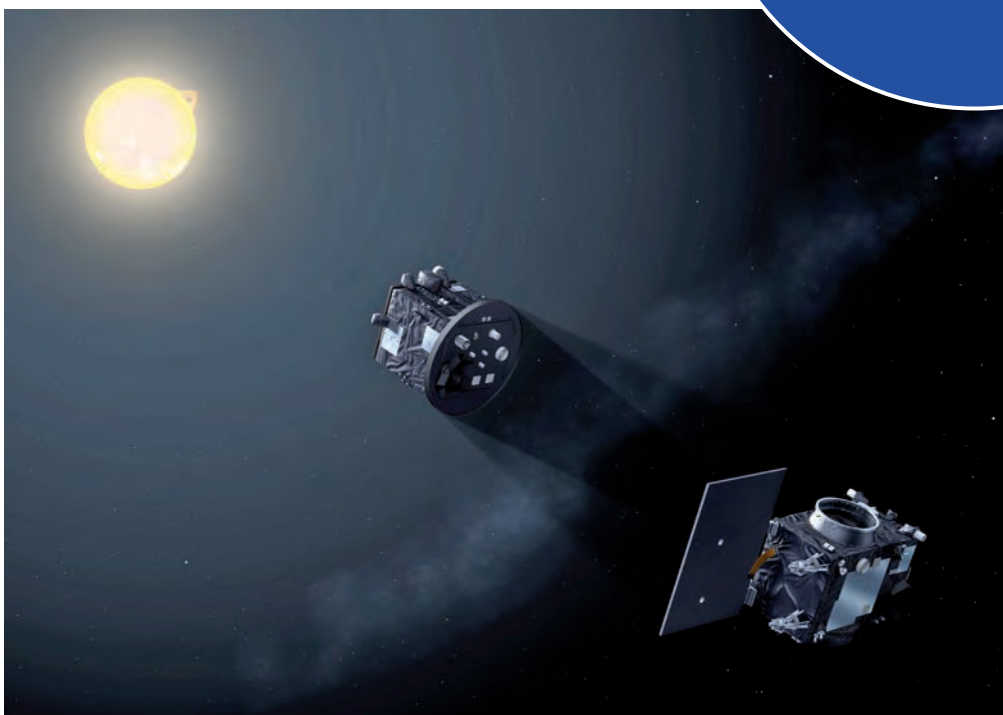


Photo: ESA

Examples of completed or on-going space-related activities

- **PROBA-3 ASPIICS payload software** – N7 Space provided the on-board software for the Coronagraph Control Box, the scientific payload computer developed by CBK/PAN in Poland, for the purpose of integration with ESA's PROBA3 mission.
- **Atmel ARM BSP with CANopen library** – as part of the Polish Industry Incentive Scheme, N7 Space develops reusable software components (Bootloader, BSP) for future radiation-hardened ARM SAMV71 (Cortex-M7) microcontrollers.
- **ASN.1/ACN modelling IDE** – within the Polish Industry Incentive Scheme, N7 Space has developed dedicated ASN.1/ACN modelling IDE. This product provides a modern development environment for the ASN.1/ACN languages used in data modelling for communication protocol design activities.
- **Deployment of the PUS-C Standard in Projects supported by an Automatic Generation Toolset (©ESA)** – as a SPACEBEL subcontractor, N7 Space participates in a study related to the deployment of automatic generation support tools for the PUS-C standard. In the scope of this activity, the company delivered PUS foundation database software, ASN.1/ACN model generator and PUS-C functional modelling in SDL and MSC languages.

Laboratories, technical facilities, infrastructure

Technical environment suitable for embedded software development for the space industry.



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Photo: ESA

NEWIND S.A.



NEWIND S.A. is an IT company established in 2010. The company has extensive experience in project implementation allowing the execution of highly advanced projects. The company employs a team of engineers with over 10 years' experience in the implementation of IT infrastructure systems monitoring, including production systems. NEWIND offers proactive protection of IT infrastructure of enterprises using MTD (Moving Target Defense) techniques. The key competence of the company is solutions for securing communication with satellites using cryptography and network techniques. The firm boasts expertise in the implementation of new data transmission protocols between satellites and ground stations in compliance with CCSDS standards. NEWIND is skilled in the application of Complex Event Processing methods to analyse events and predict anomalies in the mission control process, and has implemented projects using large data processing technologies (Big Data). As a result, it is able to create impressive applications using data and satellite imaging from missions, including configuration of ESA software.

General information

Type of entity: **SME**

Type of activity: **services**

Total employment: **59**

Number of engineers and scientists: **40**

Main areas of space activity

1. Space System Software:
Ground Systems Software
and On-Board Software
2. Quality and Safety
3. Utilization of Satellite Data,
Satellite Databases



Archiwum NEWIND

Examples of completed or on-going space-related activities

- **The Secure Communication Testbed of Space Mission [SEC_COM]** – the objectives of this mission are to study, define, and test the network and security components in the communication system between ground stations and satellites. The concept is based on the implementation of a Software Defined Network (SDN), fingerprinting signatures of hardware devices, and implementing IPS/IDS, VPN, together with performing tests in a testbed environment.
- **Exploring Encrypted Satellites Data Transfer Testbed [Crypto_SAT]** – the objective of the proposed activity is to measure the computation time overheads and drop-in bandwidth performance of data transfer via IP SEC over SDLP (CCSDS) in the space environment for various encryption algorithms and authentication methods.
- **Application of Complex Event Processing (CEP) Techniques in ESA Ground Station [CEP_GS]** – the object is to prepare a software tool supporting mission control activities. The demonstrator will provide the two main functionalities: patterns of events combinations causing anomalies, and proposed corrective actions scenarios.
- **The IT Network Security System based on SDN/NFV/MTD technology and artificial intelligence [SEC_NET]** – the project focuses on creation of an advanced cyber defence IT system using the newest revolutionary techniques as the Moving Target Defence, Network Functions Virtualisation, Software Defined Networking, and artificial intelligence algorithms.
- **Application for Monitoring of Greening Practices [CheckGREEN]** – the principal technical objective of this activity is monitoring the agro-environment-climate area for compliance with mandatory environmental practices, using Sentinel-1 and 2 imagery.

Laboratories, technical facilities, infrastructure

For the implementation of specific space projects, the company has created a dedicated test environment which includes:

- GSTVi - Ground Systems Test and Validation infrastructure;
- SCOS-2000- Satellite Control and Operation System 2000;
- SDN Controller - network management software; and
- Router - a module developed by NEWIND, among others, to perform IP encapsulation in SDLP.

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PCO S.A.



The primary activities of PCO S.A. consist of the production and sale of optoelectronic observation and aiming devices, employing laser, night vision and thermal vision technologies supplied to the military. The company is additionally engaged in research and development, along with production activities. PCO S.A. manufactures and tests optoelectronic devices for night observation and sighting in light magnification and thermal vision technologies. Its production is fully developed, designed and manufactured on-site in its own production facilities. PCO manufactures mainly small hand-held and medium-sized vehicle-mounted devices.

Optical production capabilities include: flat optical plates; optical wedges; prisms; flat and spherical mirrors; spherical and aspherical lenses of glass, germanium, and crystals; and glass technological production jigs and holders.

PCO's technological processing expertise includes: grinding; spherical and flat polishing; centering, cementing and lacquering; high vacuum coating; and testing per various mechanical, vacuum, and thermal requirements.

General information

Type of entity: **large company**

Type of activity: **production and research**

Total employment: **644**

Number of engineers and scientists: **150**

Main areas of space activity

1. Optics and Optoelectronics
2. Mechanics
3. Material Engineering



Examples of completed or on-going space-related activities

- **Coronagraph PROBA-3** (ESA) – the purpose of the Project is to demonstrate the orbit of precision flight techniques in-formation and use of applied technology for future ESA missions. PCO S.A. is responsible for the final design and construction of the mechanical structure of the *Coronagraph Optical Box* (COB).
- **CIROP** (ESA-PLIIS) – the core concept concerns introduction of IR observation to optimize performance and data transfer of the main observation system. Additional subsystems would detect the clouds covering areas of Earth surface, which impact observation and analysis.
- **PW-SAT2 Satellite** – Satellite PW-Sat2 was designed and realized by Polish students of the Warsaw Technical University. PCO S.A. manufactured several mechanical assemblies of the satellite for the PW-Sat2 Project, and additionally conducted environmental and vibration testing.
- **HESS Telescope (High Energy Stereoscopic System)** – a high-energy stereoscopic system consisting of four telescopes. As part of a cooperative effort, PCO S.A. was responsible for manufacturing certain mechanical parts and for the assembly of hydraulic rams used for the adjustment and orientation control of the telescopes' mirrors.

Laboratories, technical facilities, infrastructure

- production technology of optical elements using CNC machines and hard substrate;
- production technology for aspheric optical elements;
- SPDT – Single Point Diamond Turning;
- optical elements vacuum coating technology;
- mechanical part production technology using CNC machines;
- final assembly technology for optoelectronic devices; and
- technology for testing and acceptance of finished products.



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PIAP Space Sp. z o.o.



PIAP Space is a spin-off company for space industry activities, set up by the PIAP Institute. The company specializes in: robotics, automation, and mechanics. PIAP Space develops and offers technologies and products in areas such as: Robotic Arms and End-Effectors for on-orbit Satellite Servicing. It also provides services in the area of design and manufacturing of MGSEs, structures, and mechanisms for satellites.

General information

Type of entity: **large company**

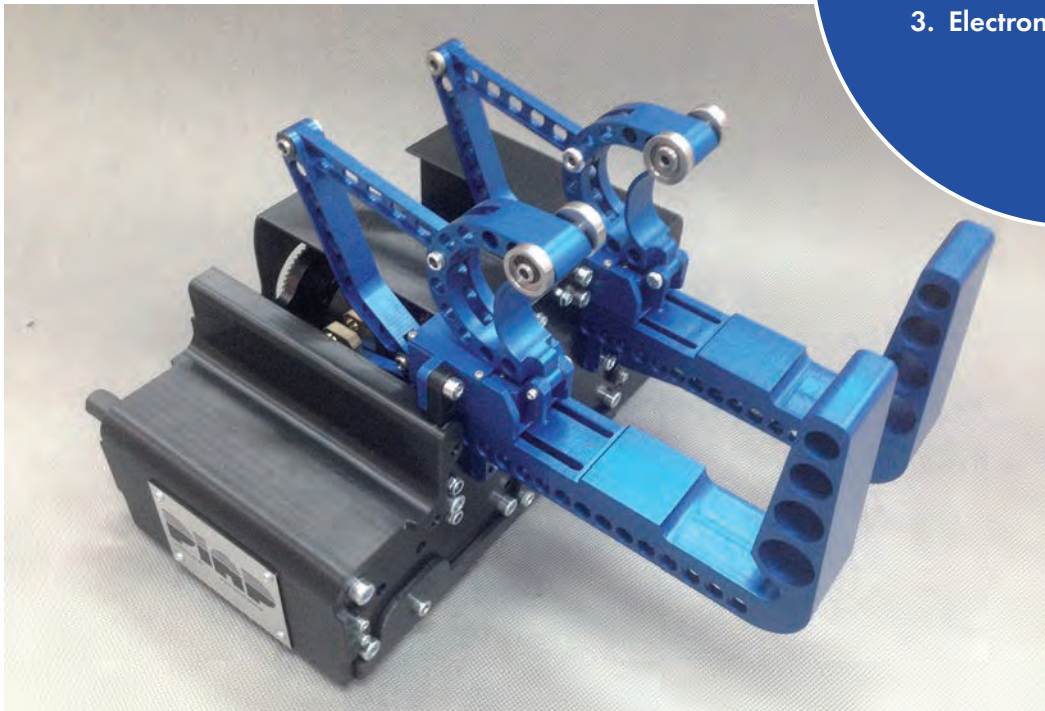
Type of activity: **production, services and research**

Total employment: **12**

Number of engineers and scientists: **7**

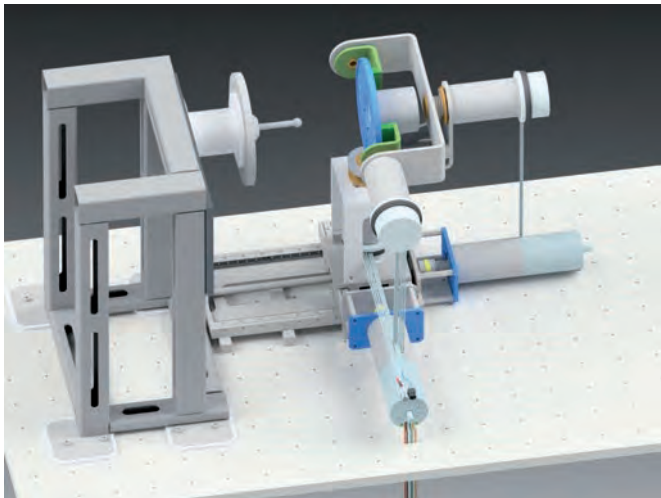
Main areas of space activity

1. Automation & Robotics, Space Systems Control
2. Mechanics
3. Electronics



Examples of completed or on-going space-related activities

- **Comrade - Control and Management of Robotics Active Debris Removal** - a joint project with Airbus D&S, GMV, and DLR based on the development of software to control robotic arms for servicing satellites. PIAP Space supplies a HIL-type gripper and a gripper contact model to facilitate interception maneuvers.
- **RaCER - Rover Speed Characterization for Lunar Exploration** – the project proposes to test the impact of delays in robotic teleoperation for lunar missions. As the reference mission, the Heracles study was adopted, which defines the most likely scenario of a Moon water-seeking mission. The mission would take place in 2027 or 2028. The project uses one of the PIAP robots as a test vehicle.
- **Biomass Adaptor** – PIAP Space is designing and manufacturing a set of three adaptors for testing and integration of the ESA Biomass satellite. Two adaptors are designed for thermal testing and satellite integration, and the third for vibration testing. Delivery is planned for the first quarter of 2019.
- **Biomass MPT - Spacecraft Container and Multi-Purpose Trolley** – PIAP Space, together with the Italian company Elital, is designing and manufacturing two MGSE for the ESA Biomass satellite. The first is a container for transporting the satellite from the integration hall to the launch site; the other is an MPT device for satellite integration. Delivery is scheduled for the second quarter of 2019.
- **Preparatory activities for short-term projects in MGSE related projects** – this project, within the scope of the PLIIS program, consists of designing an MGSE device for testing robotic elements in a vacuum chamber. An auxiliary goal of the project is to create a network of subcontractors and subcontractors in Poland that can support PIAP Space activities. Delivery is scheduled for the fourth quarter of 2018.



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ProGea 4D Sp. z o.o.

ProGea^{4D}

ProGea 4D Sp. z o.o. provides services in the field of geoinformatics. The company consists of three main departments: the Sales and Market Development Department; the LiDAR Department; and the Environmental Department. The Sales and Market Development Department deals with the distribution of satellite imagery of companies such as DigitalGlobe, Planet, and SI Imaging Services. The department is the one most associated with the space sector in the company.

In addition, ProGea 4D Sp. o.o. is the only company in Poland that resells PlanetScope satellite imagery, which is provided by the world's largest constellation of Dove nanosatellites, imaging every place on Earth almost every day. It also distributes specialized software, conducts training in the field of GIS, LiDAR, and satellite remote sensing, and performs GIS and remote sensing analysis, including imagery object classification.

General information

Type of entity: **SME**

Type of activity: **services**

Total employment: **30**

Number of engineers and scientists: **24**

Main areas of space activity

1. Others: Satellite Imagery Distribution
2. Education and Publicity
3. Utilization of Satellite Data, Satellite Databases



Examples of completed or on-going space-related activities

- **The AgroEye project** is implemented as part of a competition launched by ESA: „2nd CALL FOR OUTLINE PROPOSALS UNDER THE POLISH INDUSTRY INCENTIVE SCHEME”. ProGea programmed the OpenSource application to support the GAEC assessment, and also conducted automatic classification of Land Use/Land Cover (LULC) data.
- **The project “MONITAIR – integrated spatial data monitoring system for air quality improvement in Krakow”** was implemented within the European Economic Area Financial Mechanism at the request of the Krakow City Hall. The ProGea company provided Land Use/Land Cover digital maps, processed the data from laser scanning and high resolution satellite imagery, developed and implemented the R3 TREES greenery management system, and produced the “Land cover and ventilation Atlas of Krakow”, which included a full methodology description and results.

Laboratories, technical facilities, infrastructure

- high-performance workstations for satellite data processing;
- data processing specialized software; and
- mobile training laboratory with specialized software installed.



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Polskie Zakłady Lotnicze Sp. z o.o. – PZL Mielec



The company is the largest manufacturer of aircraft and helicopters in Poland, whose capabilities include a certified Designing, Production, and Servicing Organization, as well as an Aviation Training Center for Air Crew. Following free market rules and operating in accordance with the Code of Commercial Companies, the Company pursues manufacturing and commercial activities in the field of PZL-designed aviation products and introduces them to international markets. The company was acquired, along with Sikorsky Aircraft, by Lockheed Martin in 2015, and is currently the largest Lockheed Martin production facility outside of the United States of America.

Currently the company employs 1688 employees in its highly-skilled engineering, technical, and production departments. It also holds technical, organizational, and manufacturing certificates for designing and manufacturing aircraft and conducting aviation development programs.

The Research and Development Office, which functions within the Company's Technical Department, deals with the implementation of R&D projects for both aerospace and space industries. The Office employs experienced scientists and engineers to implement projects using its own facilities, cooperating with leading Universities and national and foreign research centers.

General information

Type of entity: **large company**

Type of activity: **production and research**

Total employment: **1688**

Number of engineers and scientists: **346**

Main areas of space activity

1. Structures
2. Mechanics



Examples of completed or on-going space-related activities

Currently the Company is expanding its R&D activities and production projects for the space industry. The Company implements research and development projects under national programs co-financed from funds of the National Centre for Research and Development. Implementation of these projects fosters enlargement of the knowledge and competencies in the field of additive manufacturing technologies, friction stir welding technology, and the use of innovative mechanical joints, composite materials, and composite structures. PZL's knowledge and experience in the use of innovative technologies creates an opportunity to perform complex projects for the space industry while ensuring the highest levels of product quality.

Laboratories, technical facilities, infrastructure

The Company features organizational and laboratory infrastructures to support research activities in a range of mechanical, chemical, metallographic, and metrological research and EMI of on-board installations and antenna systems. Its facilities additionally enable certification of PZL-designed products and performance of external services.

Other

The nature of the Company's activities ensures the adoption of appropriate procedures and maintenance of the highest standards of quality and safety. The Company has a Concession which authorizes the performance of military production and technology trade activities. Applications of classified information are supervised by the Legacy Department, the Secret Information Protection Office, and the Export Control Office.



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PZL "WARSZAWA – OKĘCIE" S.A. AIRBUS COMPANY

AIRBUS

PZL "WARSZAWA – OKĘCIE" S.A., AIRBUS COMPANY, is one of the oldest national aviation production operations, with manufacturing sites in Warsaw and Mielec. PZL heritage comes from design, manufacturing, and service of aircrafts and directly led to the establishment of a Space Commercial & Program Department to coordinate all activities in the space sector.

Currently, the space core activity is founded in electrical harness design, manufacturing, and testing. PZL employees are highly skilled and experienced professionals, certified for processes like soldering and crimping. Currently PZL provides 7000 to 9000 electrical harness bundles annually for its customers and for domestic programs. The Company manages projects in design and manufacturing of electrical harnesses, providing equipment principally for the European Space Agency (it is among the 10 largest Polish providers to ESA) and Airbus Group entities.

PZL has built a Clean Room Area of around 500m² to an ISO-8 standard to be ready to manufacture spaceflight components and for future integration of satellites.

General information

Type of entity: **large company**

Type of activity: **production and research**

Total employment: **687**

Number of engineers and scientists: **71**

Main areas of space activity

1. Electronics
2. Material Engineering
3. Mechanics



Examples of completed or on-going space-related activities

- **MetOp SG** – Engineering Model harness manufacturing for the second generation of MetOp Satellites.
- **JUICE** – Flight Model harness manufacturing for the exploration of Jupiter’s moons.
- **JUICE RPWI** – Flight Model harness manufacturing for a Radio and Plasma Wave Instrument for the JUICE mission.
- **AIT** – assembly, integration, and testing of satellite harnesses and structures.
- **ESA BIC** – participation in creation of the Business Incubation Center of the European Space Agency dedicated for the development of start-ups.

Laboratories, technical facilities, infrastructure

Chemical Laboratory, Meteorological Laboratory, Equipment Laboratory, Temperature Measurement Laboratory, Metallography and mechanical Laboratory, Clean Room ISO-8.

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SATIM Satellite Monitoring Sp. z o.o.



SATIM Satellite Monitoring LLC is a company established as a spin-off company of the AGH University of Science and Technology in Krakow. The founders of SATIM are employees of the Department of Geoinformatics and Applied Computer Science AGH and the Krakow Center for Innovative Technologies InnoAGH LLC. In their scientific work, the founders of SATIM deal with the development of methods for processing and analysis of satellite radar imagery (including polarimetric images), as well as the development of possible radar satellite image applications. They have extensive experience in scientific and commercial projects at both the national and international level. Among others, they have cooperated with EADS Astrium/Airbus D&S, Europe's largest provider of specialized systems and services in the space industry. They also took part in the international EnerGEO project, which was financed from the EU's Seventh Framework Program (FP7). In recent years, they are partnered with ESA and others as part of several research and development projects.

General information

Type of entity: **SME**

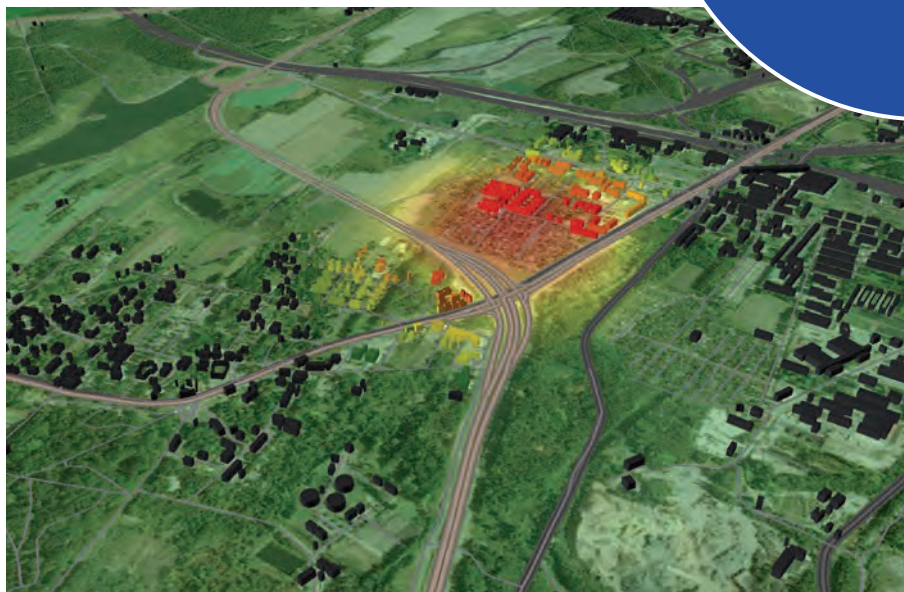
Type of activity: **services**

Total employment: **7**

Number of engineers and scientists: **5**

Main areas of space activity

1. Utilization of Satellite Data, Satellite Databases
2. Others: GIS (Geospatial Information Systems)

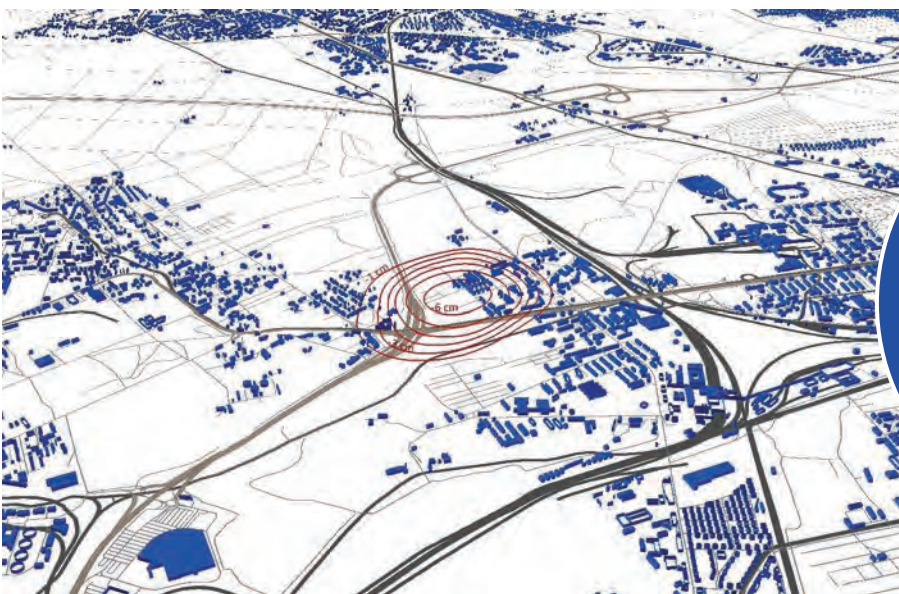


Examples of completed or on-going space-related activities

- **“Improvement of ground deformations monitoring within urban areas based on dual-pol SAR data in Warsaw city”** – the project concerned monitoring of slow surface deformations in urban areas using radar data. The PSI method was used. The project enabled the gathering of experience in the field of building-monitoring located along the second line of the Warsaw subway. GIS analysis tools were also used to establish the correlation of the resulting deformations with the route of the tunnel.
- **“Development of PolSARPro functionalities by implementing new data processing and visualization methods”** – the project concerned the implementation of new radar image processing tools for the PolSARPro software. Tools for data visualization were additionally developed.
- **“Innovative EO-based products for oil and gas sector”** – the project included the development of algorithms for the identification of lineaments in desert areas using satellite data. An important stage of the project was also the use of GIS analysis to plan the optimal route of pipelines between the dunes.
- **“MineSAR - the highly automated software for the monitoring of mining-induced ground deformations within large areas”** – the project was aimed at gathering the existing base of knowledge and experience regarding the monitoring of post-mining induced ground subsidence phenomenon. As a result of the project, independent software (MineSAR) was created to detect and analyze land deformation occurring in the areas of underground mining. MineSAR automatically generates terrain subsidence maps, terrain subsidence isolines, as well as alarms/notifications when the values of terrain subsidence exceed the threshold values.

Other

SATIM is the first company in Poland that uses satellite and aerial imaging (both radar and optical) in so many environmental applications. Its employees have the necessary knowledge and experience to carry out advanced analysis, including assessment of natural hazards, the impact of mining on the environment, changes in land development, urban development, stability of buildings and infrastructure, and road deformations. The SATIM company performs remote sensing data processing using classic algorithms, as well as using its own improved versions developed by SATIM employees.



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SATREVOLUTION S.A.



SatRevolution is a Polish NewSpace company established in 2016, developing Poland's first commercial satellite – Światowid. It specializes in the production of satellite platforms and other satellite components for nano- and micro-satellites. The company is conducting a number of R&D projects with organizations, such as: Université Grenoble Alpes, AGH University of Science and Technology, EIT+ Wrocław, etc. SatRevolution is also developing innovative satellite propulsion and communication systems. The Company's testing facilities include: TVAC and EMC chambers, microscopes for PCB inspections, and solar radiation simulators for photovoltaics testing.

General information

Type of entity: **SME**

Type of activity: **production, services, research and science**

Total employment: **17**

Number of engineers and scientists: **14**

Main areas of space activity

1. Electronics
2. Power systems and Propulsion
3. Optics and Optoelectronics



Examples of completed or on-going space-related activities

- **Światowid** – first Polish commercial Earth Observation satellite proof-of-concept. Individual nanosatellite design, production, and integration.
- **SR-NANO-BUS** – small satellite scalable platform. In-house design of a complete nanosatellite platform, including OBC, EPS, ADCS, UHF/S-band subsystems, and chassis.
- **AMICal Sat** – SR-NANO-BUS platform production, and satellite integration for a low-light condition auroral observations experiment, in cooperation with University of Grenoble Space Center (CSUG).
- **KrakSat** – SR-NANO-BUS platform production, and satellite integration for a ferro-fluid reaction wheel experiment, in cooperation with AGH in Cracow.
- **Other R&D projects** – Nanosatellite PPT ion thruster development; terahertz array antenna project, with patent pending.

Laboratories, technical facilities, infrastructure

4 Clean rooms, TVAC chamber (target temperature: 218/423 K; pressure: 10-5 mbar), EMC testing compartment, solar light simulator, access to research facilities of EIT+ in Wrocław (Poland's leading R&D institute).

Other

The Company's projects are developed by a skilled team of engineers whose previous experiences include work on the Martian rover Scorpio, BepiColombo, etc. The Company aims to launch a constellation of nanosatellites in the near future (using its technologies such as the SR-NANO-BUS).



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SENER Sp. z o.o.



Since 2012, SENER Poland has focused on developing innovative solutions in space engineering for projects of ESA, NASA, and ESO. SENER Poland specializes in two fields of mechanical engineering:

- deployment and hold-down mechanisms – for transportation of space vehicles in launch vehicle-processing spaces, and for subsequent deployment of solar panels, antennas and measuring instruments; and
- mechanical ground support equipment (MGSE) – used, e.g., for precise repositioning of satellites in order to facilitate access for technicians, and for transportation to test chambers and loading spaces. There are just a few companies in Europe that design such devices.

SENER Poland cooperates with 50 Polish partners (on average, receiving 45% of the projects' value through contracts for services and products). In this way, SENER makes it easier for partners to independently acquire international space sector clients and provides a positive boost to the Polish economy. The company also invests in the personal development of its employees. Within 5 years, the SENER Poland team responsible for space projects has grown from 3 to 37 people.

General information

Type of entity: **large company**

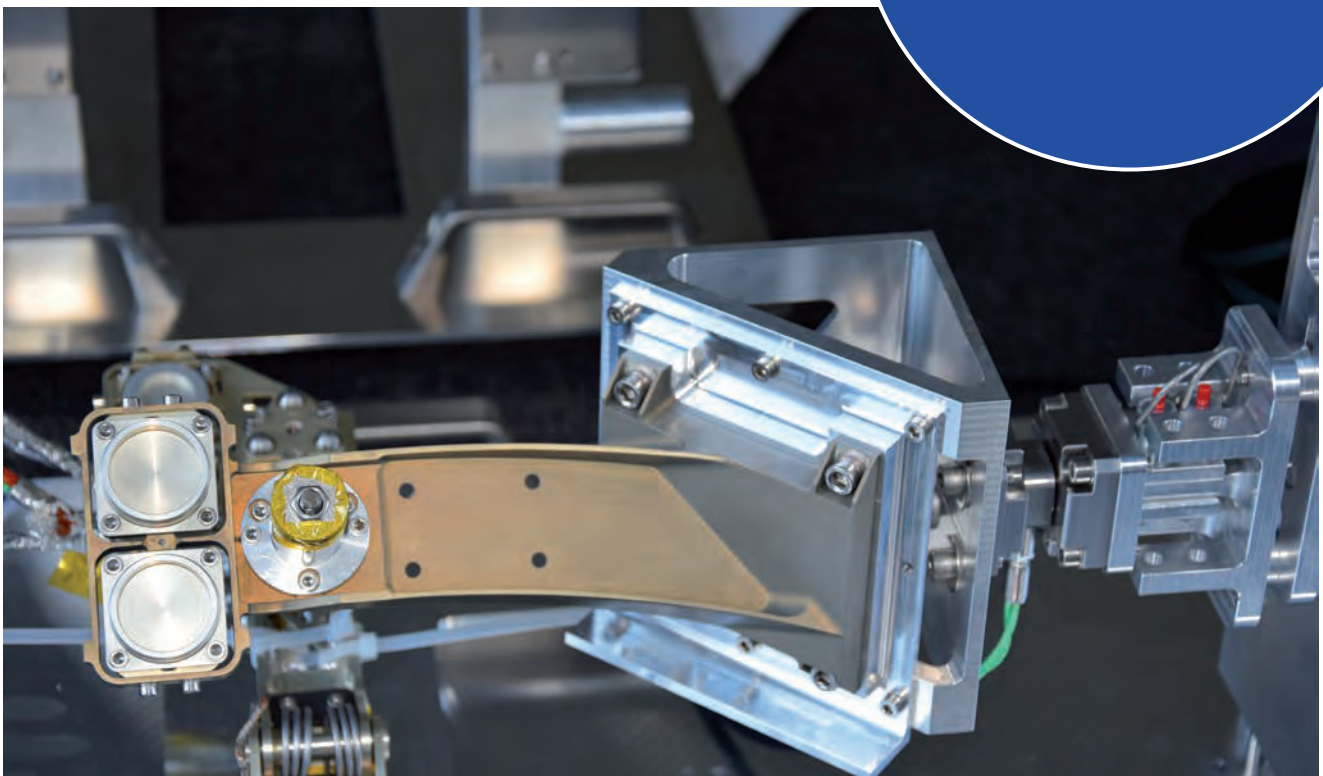
Type of activity: **production**

Total employment: **37**

Number of engineers and scientists: **30**

Main areas of space activity

1. **Mechanics**
2. **Structures**
3. **Automation & Robotics, Space Systems Control**



Examples of completed or on-going space-related activities

- **International Berthing Docking Mechanism (IBDM)** – innovative system for docking and berthing of space vehicles to be employed on space shuttles, including Sierra Nevada's Dream Chaser. SENER Poland will design and manufacture key components, including: mechanisms for connecting and disconnecting electrical joints; separation mechanisms; monitoring sensors for docking, berthing and unberthing; and a protective cover for the system.
- **The Euclid mission** – development of a set of 13 MGSE devices supporting the process of satellite assembly.
- **The ExoMars mission** – design, manufacturing, testing, and assembly of the Umbilical Release Mechanism connecting the rover with the transport vehicle and providing power supply during the process of robot activation on the Mars surface. (EM/QM/FM)
- **The ATHENA mission** – design, manufacturing, testing, and assembly of a mechanism for changing the focal position of an orbital telescope operating in the X-ray range. (EM)
- **Extremely Large Telescope** – development of MGSE; specifically, devices for assembly, transport, and protection of the M2 and M3 mirrors of the largest optical telescope in the world.

Laboratories, technical facilities, infrastructure

- 40m² clean room ISO8/ISO5;
- 30 m² laboratory.

Other

Detailed fields of activity:

- Electromechanical systems: mechanisms for deploying antenna extension arms and structures, linear and rotary actuators, antenna pointing mechanisms, blocking and releasing mechanisms, structures; and
- Mechanical Ground Support Equipment (MGSE): horizontal lifting devices, vertical lifting devices, transport trolleys, clamp bands, and containers.



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SKA Polska Sp. z o.o.



SKA Polska is a company that provides comprehensive research and development services, particularly for the design of advanced robotic and measuring devices, electronics and control systems, optical and vision systems, and for the conduct of simulation analysis covering many physical phenomena and numerical optimization. SKA Polska participates in international research projects - developing new technologies (as part of grants awarded from, among others, the Horizon2020 program), and fulfilling commercial orders - solving customers' technological problems and helping to develop and market their products. As part of its projects, the firm cooperates with numerous research centers in Poland and abroad, including the European Space Agency, for which it develops technologies related to the removal of space debris.

In 2012, the company was recognized by the MSN Scientific Network and the Institute of Economics of the Polish Academy of Sciences as one of the 500 most innovative companies in Poland; while, in 2015 at the Meet The Space conference, it was honored for significant contributions to the development of the Polish space industry.

General information

Type of entity: **SME**

Type of activity: **services, research and science**

Total employment: **12**

Number of engineers and scientists: **12**

Main areas of space activity

1. **Others: Space debris removal technologies**
2. **Space System Software: Ground Systems Software and On-Board Software**
3. **Automation & Robotics, Space Systems Control**



Examples of completed or on-going space-related activities

- **ADriNET** – simulation software for the process of capturing space debris using a net, and validation for the system in parabolic flight.
- **ADRIEN** – a prototype of a full-scale subsystem to capture space debris using a net.
- **HORUS** – a prototype of a wearable holographic display applied to support the assembly of precision devices.

Laboratories, technical facilities, infrastructure

- laboratory and workshop facilities supporting construction of mechanical and electronic prototypes;
- optical table for measurements and building prototypes of optical devices;
- measurement equipment and software for data acquisition and processing;
- optical profilometer; and
- tensile machine.



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SpaceForest Sp. z o.o.



SpaceForest develops and commercializes new technologies concentrating on microwave techniques, artificial intelligence, and electronic and rocket technologies. The company's most valuable asset is its highly-educated, experienced, and ambitious team of employees. SpaceForest's designers, engineers, and programmers have proven experience in European Space Agency and Space-Tech companies' projects. The company uses specialized design and simulation software, measuring equipment, and a machine park which enable its capable management of even the most demanding and sophisticated orders.

SpaceForest's projects incorporate the design and creation of prototypes of subsystems for satellite technologies, in particular WPT (Wireless Power Transfer) and Wireless Sensor Networks applied in aerospace systems.

General information

Type of entity: **SME**

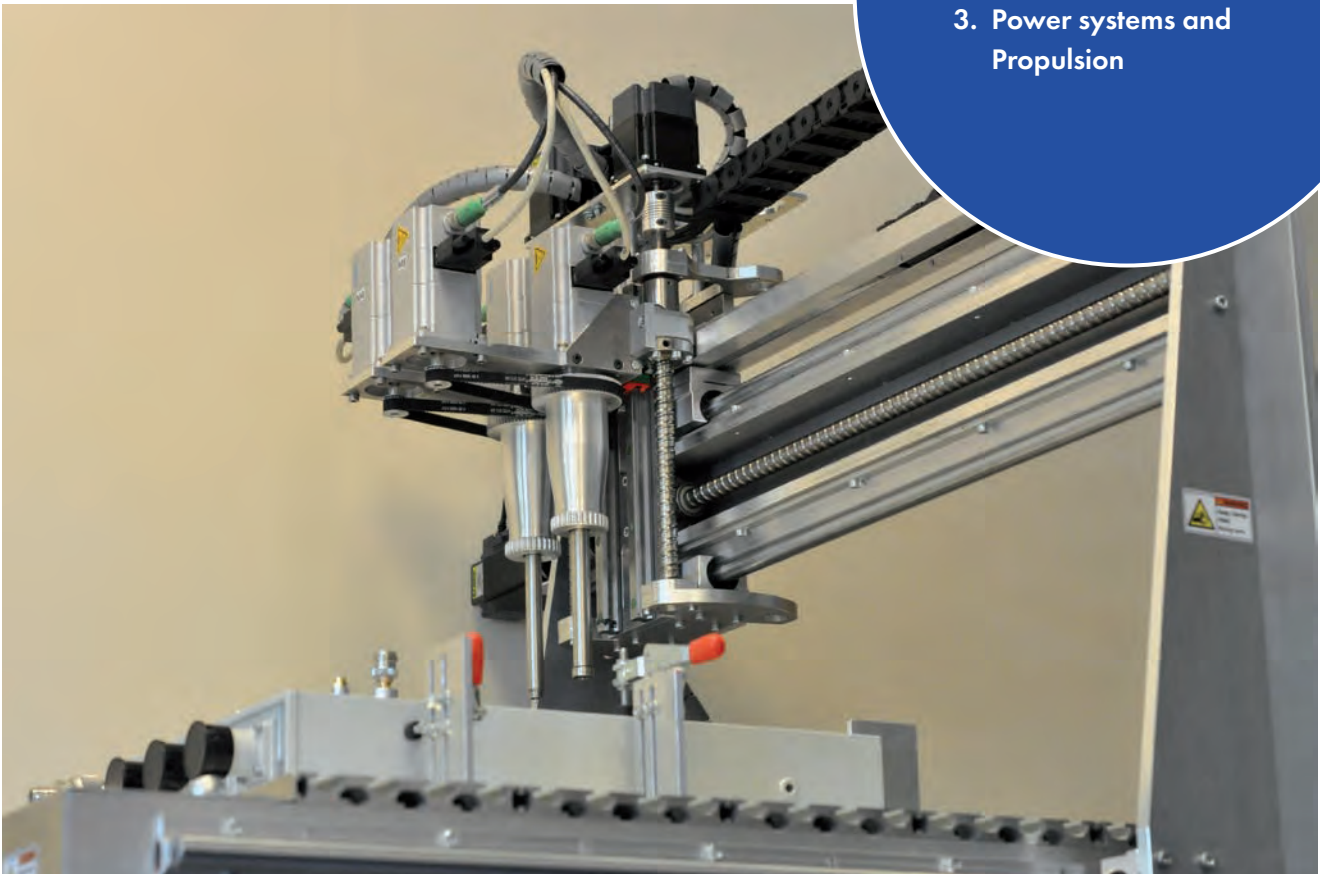
Type of activity: **services, research and science**

Total employment: **21**

Number of engineers and scientists: **18**

Main areas of space activity

1. Electronics
2. Mechanics
3. Power systems and Propulsion



Examples of completed or on-going space-related activities

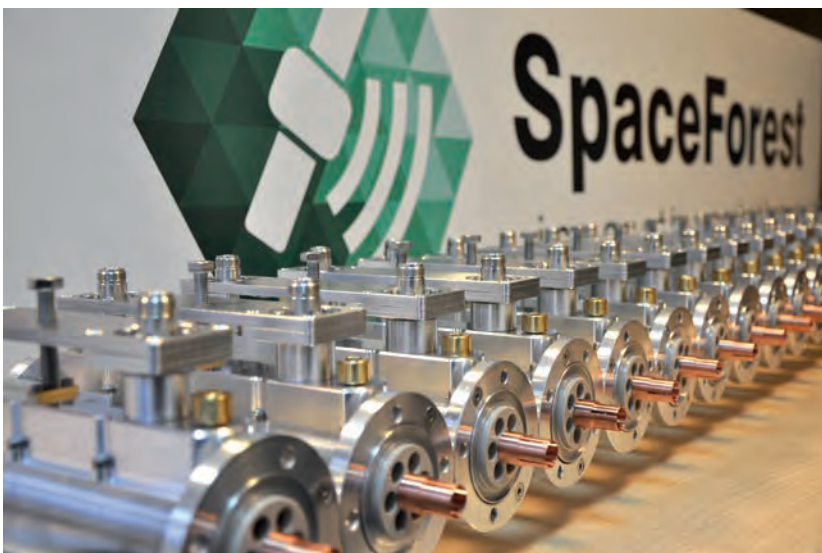
- **„DEWI” – Dependable Electronics for Wireless Infrastructure** (European Commission, Artemis programme)
– SpaceForest was in charge of several tasks whose main goal was to create and test a wireless sensor network (WSN) for use on-board various flight vehicles, including launchers and sounding rockets. The chief outcome of the project was a demonstration of the WSN integrated with a “Candle 2” research rocket, which was twice successfully tested in flight conditions, achieving TRL-4.
- **“Development of key technologies for frequency generators”** – project for ESA within the PLIIS program, with RUAG Space from Sweden as a project partner. During the project, SpaceForest built three different breadboards of low phase-noise/phase-locked frequency generators based on dielectric resonators, meeting the stringent requirements of purity for the generated signals. The solution reached TRL 4 for a frequency range of 3-12 GHz.
- **“Development and qualification of frequency generators”** – project for ESA, in partnership with RUAG Space from Sweden. This project is a continuation of the “Development of key technologies for frequency generators” within PLIIS. The technology reached TRL-6 – Engineering Qualified Model.
- **“Development and qualification of dual redundant medium-power master signal source”** – project for ESA, in collaboration with RUAG Space from Sweden. The principal outcome of the project will be a dual-redundant MSS (Master Signal Source) designed for the use on-board telecommunications satellites. The MSS will reach TRL-6 within two years of project commencement.
- **„SIR” – Suborbital Inexpensive Rocket** – project co-financed by the National Centre for Research and Development (NCBiR). As part of the project, an unmanned, controllable and recoverable SIR rocket will be created, capable of carrying 50 kg of cargo to a minimum of 100 km above sea level. A hybrid drive, based on ecological and safe propellants, will be employed, using a combination of N₂O (nitrous oxide) and paraffin.

Laboratories, technical facilities, infrastructure

SpaceForest operates electronic and microwave measuring devices, such as VNA's, Spectrum Analyzers, Signal Source Analyzers, Digital Oscilloscopes, Climate Chambers, and other advanced equipment. The company has specialized design and simulation software, including ADS, CST, AWR Microwave Office, and variety of other software tools for PCB Design and CAD.

Other

SpaceForest offers CNC and manual machining of various materials, such as steel, aluminum alloys, brass, copper, polymers, composites, and others. The company specializes in design and manufacture of precision housings for space industry electronic devices. Its manufacturing services extend to other industries, as well.



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Spacive Sp. z o.o.



The company specializes in thermal systems, mechanisms, space robotics, and electronics. Spacive Sp. z o. o. created a unique „layer-by-layer“ MLI-type insulation, which achieves twice the level of insulative properties of other materials. The company offers services for development, manufacturing, and testing MLI insulation, development of thermal control systems for satellites and their components, and thermal vacuum tests at different project stages. Spacive Sp. z o. o. also offers structural analysis for space applications using the Patran/Nastran environment or Ansys. It also has broad experience with design and simulation of space mechanisms (e.g., participation in the JUICE mission) and in designing electronic circuits. The company has completed numerous projects for domestic and foreign entities, including ESA.

General information

Type of entity: **SME**

Type of activity: **services**

Total employment: **4**

Number of engineers and scientists: **4**

Main areas of space activity

1. Others: Thermal
2. Structures
3. Mechanics



Examples of completed or on-going space-related activities

- **“Development of 3D MLI and 3D test bed system for MLI properties measurement”** (ESA) – Spacive, as a main contractor for this project, introduced a new method for the MLI manufacturing process, called “layer-by-layer”, in order to enhance the insulative properties of the blanket. A set of thermal simulations and tests were performed, and it was proved that the method is especially effective for small objects with large edge areas.
- **“Development of Multi-Layer Insulation technology”** – Spacive is engaged in this project to further develop MLI modelling technology, especially MLI manufactured via the “layer-by-layer” method. Additionally, commercial solutions are being prepared through the performance of a set of qualification tests.
- Participation in the **JUICE** project (ESA) – the company is responsible for development of SWI (Submillimetre Wave Instrument) for the JUICE mission. There is already a 3rd contract in-work between Spacive and the Max Planck Institute for Solar System Research in Göttingen. The prime objectives are construction of mechanisms and structures of the instrument, analytical calculations of mechanical components, and structural simulations for instruments.
- **“Development and validation of a laboratory model of a space robot containing a set of resistojet engines”** (RR-Space) – Spacive has performed thermal analysis and vacuum tests for the components of the resistojet engine power system. Additionally, a heater control system was developed, and a cold gas and resistojet engine electrical control system were integrated.

Laboratories, technical facilities, infrastructure

Cooling chamber/vacuum chamber for simulation of the space environment, with temperatures as low as -196°C . Dimension limits for tested equipment: 700mm x 230mm x 230mm.

Other

Spacive Sp. z o.o., is a spin-off company founded in 2014 by a CBK group of managers and engineers. The company cooperates with a group of engineers from different specializations, providing services for entities of the space sector. It conducts its own research and development in MLI insulation technology and space environment simulations.



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SYDERAL Polska Sp. z o.o.

SYDERALPOLSKA
ELECTRONICS & SOFTWARE

SYDERAL Polska is a Polish SME providing electronics and software solutions for the space sector. The company was established in 2016 as a joint venture of SYDERAL SA, a Swiss company with over 25 years of experience in the space market, and 3CityElectronics, a Polish SME active in the industrial electronics field.

SYDERAL Polska's mission is the delivery of high-quality products while maintaining a readiness for applying innovative solutions within the space technology domain. Electronics and software products for our clients are designed by first-rate Polish engineers with deep experience in the space sector.

SYDERAL Polska provides services and products in the following areas:

- Mechanisms and Memory Module Controllers;
- COTS-based Integrated Avionics;
- FPGA-based systems design; and
- RF Electronics.

General information

Type of entity: **SME**

Type of activity: **services and research**

Total employment: **8**

Number of engineers and scientists: **8**

Main areas of space activity

1. Electronics
2. Automation & Robotics, Space Systems Control
3. Space System Software: Ground Systems Software and On-Board Software

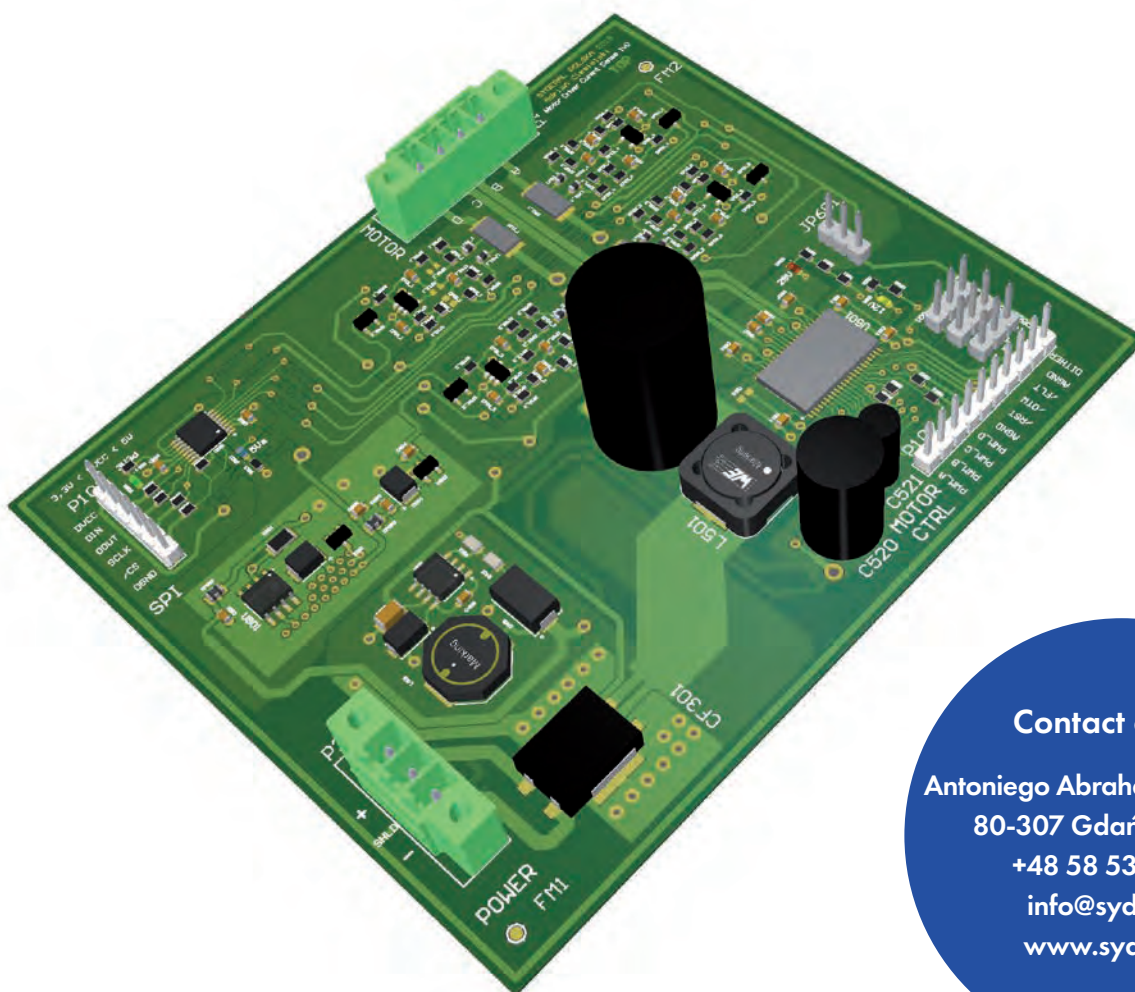


Examples of completed or on-going space-related activities

- **Motor Controller Demonstrator** (ESA, PLIIS) – the main aim of this project is to develop a stepper motor controller based on ECSS standards and the SpaceWire RMAP communication protocol. The project includes: FPGA modules development, PCB design, and Manufacturing and testing.
- **EUCLID Antenna Deployment and Pointing Mechanism Electronics** – FPGA module development, EGSE testing software.
- **FLEX, FLORIS Instrument Control Unit** – FPGA module development, software programming for PUS (Packet Utilization Standard) handling, and PCB design for the Power Supply and Driver modules.

Laboratories, technical facilities, infrastructure

- engineering computer software: Riviera PRO, Altium Designer;
- basic laboratory equipment for electronics prototyping and testing; and
- access to production and testing laboratory belonging to 3CityElectronics (one of SYDERAL Polska's shareholders). This facility is equipped with instrumentation, such as: a 1 GHz-6 GHz semi-anechoic chamber, Mantis Vision stereo microscope x6, soldering stations, oscilloscopes, signal generators, and power supplies.



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The Silesian Science and Technology Centre of Aviation Industry Sp. z o.o.



Silesian Science
and Technology Centre
of Aviation Industry Ltd.

The Centre is one of the most modern European innovation facilities. The core areas of the Centre's activity are development and production of light and durable composite materials for the aviation and space industries. At the same time, the Centre successfully conducts its own research projects and provides services to its clients throughout every stage of composites construction – from design to production of finished parts. Its advanced applied technology and cutting-edge equipment allows the Centre to maintain the highest quality of service. The activity and technical infrastructure of the Centre consists of two basic components:

- Composites Structures Department that designs and produces complete composite structures or their components by autoclaved technology. In addition to production of elements by autoclaving from conventional prepreg systems, the Centre also produces ultra-thin ply laminates (so-called thin ply technology); and
- Materials Research Laboratory, whose range of research includes static and fatigue tests of completed products or their components.

The Company is constantly interested in new challenges and cooperation with partners, especially in the area of implementation of innovation, not only in aviation and space, but also in other industries – wherever the use of light and ultra-light, durable materials is required.

General information

Type of entity: **large company**

Type of activity: **production, services and research**

Total employment: **26**

Number of engineers and scientists: **10**

Main areas of space activity

1. **Material Engineering**
2. **Others: Tests, Material research**
3. **Structures**



Examples of completed or on-going space-related activities

- **„Validation of CFRP substrates manufacturing process for SPACECRAFT Structures”** – project carried out in cooperation with TAS-France. The scope of the project is completion of the manufacturing cycle, and testing of samples and “full scale” CFRP epoxies panels, based on the partner’s standard structural platform design.
- **„Cyanate-ester composite technology demonstration for space telescopes”** – project carried out in cooperation with TAS-France. The project’s purpose is to extend the know-how, competencies, and requirements associated with manufacturing and testing of panels made of CFRP cyanate-ester pre-pregs.
- **„Implementation of aluminum sandwich panels manufacturing processes for spacecraft structures in the Silesian Science and Technology Centre of Aviation Industry Ltd. – Qualification”** – project carried out in cooperation with TAS-France. The project allowed the Centre gain experience in the manufacturing and testing of aluminum panels.
- **„SAT-AIS-PL Phase A”** – project carried out under Creotech Instruments S.A. leadership. The Centre’s participation consisted of initial design of the structure of the first Polish commercial satellite for monitoring maritime traffic, mechanical simulations, and preparation of input data for structure components.

Laboratories, technical facilities, infrastructure

- Composites Structures Department: clean room with a 10,000-class cleanliness, 2 autoclaves, 5-axle CNC milling centre, and ultra-thin ply processing equipment; and
- Materials Research Laboratory: electro-dynamic shaker, thermo-climatic chamber, a set of actuators for static structural testing, servo-hydraulic load frame for axial/torsional force, and a high-speed camera (500,000 fps). The Laboratory is accredited by the Polish Centre for Accreditation.

Other

Currently, the Silesian Science and Technology Centre of Aviation Industry Ltd. is one of the most experienced Polish institutions in the field of manufacturing sandwich panels for the structures of satellites and other spacecraft.



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Thales Alenia Space Polska Sp. z o.o.



The company belongs to the French group Thales Alenia Space. For more than 40 years, Thales Alenia Space has designed, integrated, tested, operated and delivered innovative space systems. Its cutting-edge products and services meet the needs of commercial and government customers from around the world, spanning the space, defense, science and security markets. Thales Alenia Space's satellites and payloads are recognized worldwide as benchmarks in delivering communications and navigation services, monitoring our environment and the oceans, better understanding climate change and supporting scientific research. Today, Thales Alenia Space is one of the main suppliers to the International Space Station, and a pivotal player in systems to explore our Universe.

Thales Alenia Space is a joint venture between Thales (67%) and Finmeccanica (33%). Along with Telespazio, Thales Alenia Space forms the Space Alliance, which offers a complete range of solutions and services. Because of its unrivaled expertise in dual-use (civil-military) missions, constellations, flexible payloads, altimetry, meteorology and high-resolution radar and optical observation, Thales Alenia Space is a natural partner for countries that want to expand their space programs.

General information

Type of entity: **large company**

Type of activity: **production, services and research**

Total employment:

8000 (in 9 countries)

Main areas of space activity

1. Others: LSI (Large System Integrator)
2. Structures
3. Mechanics



Examples of completed or on-going space-related activities

Major projects conducted by the Thales Alenia Space group: Iridium NEXT (constellation of 81 telecommunication satellites), EUMETSAT Meteosat, Copernicus Program (satellites Sentinel-1 and 3), several telecommunication satellites, constellation Cosmo-SkyMed. Moreover, the group has conducted several science missions, including: Cassini-Huygens, Euclid, ExoMars, as well as technology demonstrators, e. g.: Galileo GIOVE-B, IXV, and Stratobus.

Laboratories, technical facilities, infrastructure

Full production, integration and testing facilities located in several centers in Europe.

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Ultratech Sp. z o.o.



Ultratech is a private limited company founded in 2000 and a member-founder of the Aviation Valley cluster; from the very beginning of its existence, it has actively worked for aviation-related development and advancement. Currently, the company employs 99 employees. Ultratech has experience in aviation personnel, high-quality machining and measuring machines, all necessary certificates, and enthusiastic approvals from its clients. It specializes in the production of aviation parts, mainly aircraft landing gear components, engine blades, and large structural elements.

In addition, Ultratech has many years of experience in the production of parts for the aerospace and turbine industries, including blades for gas, steam, and water turbines. It additionally designs and produces tooling equipment with both mechanical and hydraulic fastening and measuring instruments for its own needs and in the service of other companies. Ultratech performs defectoscopic non-destructive testing on a special FPI line approved by NADCAP. The company participates in numerous research projects developing and implementing new technologies for production.

General information

Type of entity: **SME**

Type of activity: **production, services and research**

Total employment: **99**

Number of engineers and scientists: **10**

Main areas of space activity

1. **Others: Production of equipment elements for domestic and foreign customers**



Examples of completed or on-going space-related activities

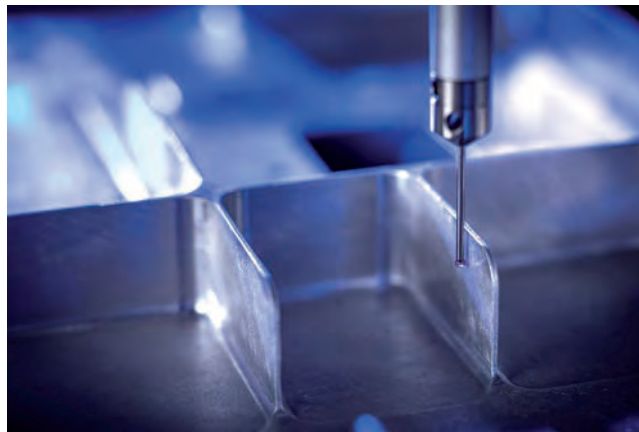
- production of parts for ExoMars project;
- production of parts for SAOCOM-CS project;
- production of parts for EM-RTU mechanism;
- production of parts for PACKMOON project; and
- production of parts for meteorological satellite.

Laboratories, technical facilities, infrastructure

The company has a technology office and a design office that are fully-equipped with necessary hardware and CAD/CAM software. Ultratech also has a non-destructive FPI line approved by NADCAP.

Other

Ultratech has the highest-class 5-axis machining centers, which enable high-precision machining of difficult-to-cut materials.



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VIGO System S.A.



VIGO System S.A. is the leading manufacturer of standard and customized High Operating Temperature HgCdTe detectors. The mission of VIGO System is to provide fast and easy-to-use IR detectors at any wavelength from 1 to 16 μm , reaching fundamental BLIP limits without cryocooling.

One of VIGO System's most prestigious customers is NASA, for whom VIGO System developed uncooled infrared detectors for use in a Tunable Laser Spectrometer instrument designed to acquire information about the Martian environment during the Mars Science Laboratory mission.

The detectors developed and manufactured at VIGO System have an indisputable advantage over other detectors in-use today – they operate without cryocooling. VIGO System supplies unique high-tech products, manufactured with the use of internally-developed technology. The highest performance components are in most cases customer-driven solutions for specific applications. The competitive advantage of the company is based on the unique high-performance and quality of its many products.

General information

Type of entity: **SME**

Type of activity: **production and research**

Total employment: **100**

Number of engineers and scientists: **57**

Main areas of space activity

1. Optics and Optoelectronics



Examples of completed or on-going space-related activities

Infrared detectors manufactured by VIGO System S.A. are currently being used by American, European, and Russian Space Agencies to explore Mars in two different programs: in MSL, where the detector is a part of the tunable laser spectrometer in the Curiosity rover (NASA), and in ExoMars (ESA and ROSCOSMOS), where VIGO System products are included in the ICOTOM radiometer, used to monitor the outer layers of spacecraft landers.

Laboratories, technical facilities, infrastructure

- MOCVD and MBE epitaxy
- acoustic and laser-based sensor production controlling
- semiconductor layers characterization by transmittance, Hall's parameters, and photoelectric properties measurements
- mask aligner and spinner for photolithographic processes
- sputter coaters with metal targets
- ICP digester and diamond saws
- Automatic Wire Bonder

Other

VIGO System designs and produces electronic components dedicated to IR detectors, including preamplifiers, TEC controllers, power supplies, and mechanical accessories. Detection modules are characterized by high detectivity in a broad spectral range from 1 to 16 μm , bandwidth up to 1 GHz, and operation temperatures from 200 to 300 K.



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Wasat Sp. z o.o.



Wasat provides services based on satellite remote sensing systems, geographic information systems, and related IT for clients in the agriculture, environmental protection, and archaeology sectors. The company also develops innovative tools for satellite data processing and analysis.

Examples of completed or on-going space-related activities

- **„Jupyter-based IDE as an interactive and collaborative environment for development of notebook style EO algorithms on Network of Exploitation Platforms infrastructure”** – Wasat adapted solutions based on Jupyter Notebook for processing Earth Observation data in a cloud environment. The products support developers of satellite applications and EO scientists in the creation of data processing algorithms and in visualization of information or services.
- **„Mobile platform for deployment of HMA standardized services into different types of mobile system environments”** – Wasat developed the software for discovery and distribution of EO data and services, in a form acceptable by mobile devices and based on Open Geospatial Consortium and Heterogeneous Missions Accessibility specifications.
- **„Archaeological application of Earth Observation techniques”** – Wasat evaluated the usability of Earth Observation techniques for discovery and analysis of archaeological heritage sites in specific Central European conditions. The company validated available EO-based data sources and tools and developed methods responsive to the requirements of archaeologists.
- **„Satellite applications for high-value horticultural production”** – Wasat developed a service that provides growers with maps of fields divided into management zones that have become a basic tool in precision agriculture. Additionally, the service delivers daily actual evapo-transpiration values that support decision-making on irrigation of horticultural plantations.
- **„Earth Observation for South East Europe”** – within the framework of a multinational project, Wasat developed algorithms for semi-automatic classification of cultural landscapes based on analyses of satellite data available in the Copernicus program.

General information

Type of entity: **SME**

Type of activity: **Services**

Total employment: **7**

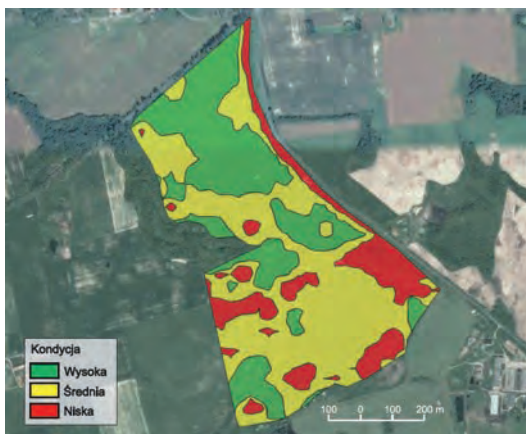
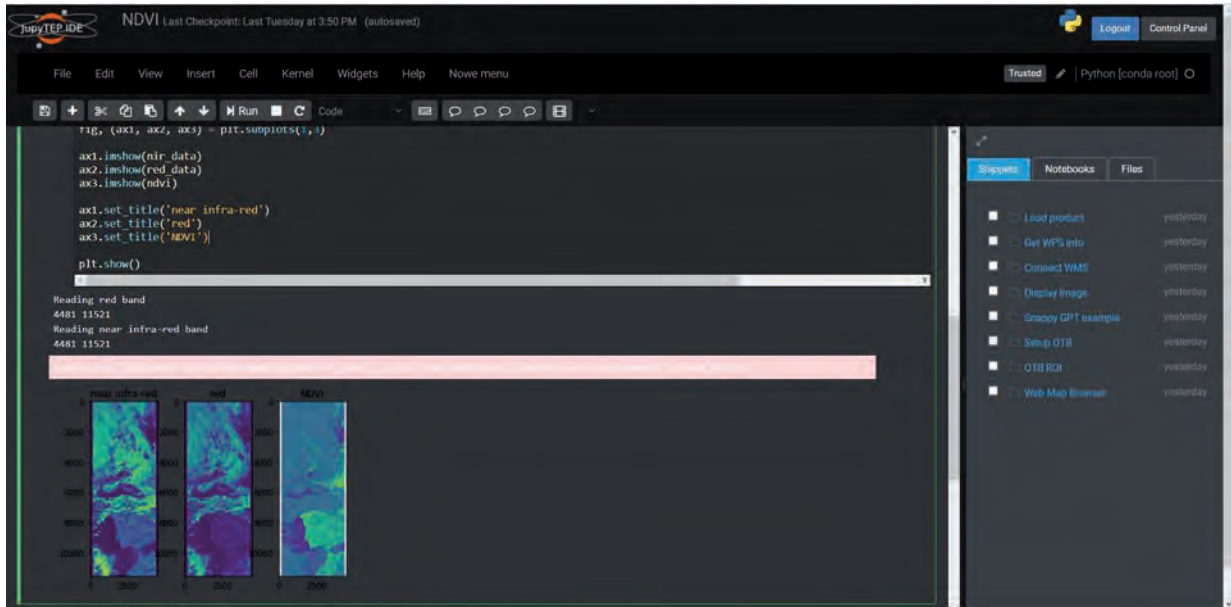
Number of engineers and scientists: **5**

Main areas of space activity

1. Utilization of Satellite Data, Satellite Databases

Laboratories, technical facilities, infrastructure

Servers, workstations, and software enabling the collection, processing, and analysis of satellite data and visualization of geoinformatics products.



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WiRan Sp. z o.o.



WiRan has been a comprehensive RF solutions provider since 2002. It is experienced in the aerospace, military, rail, and IoT markets, with particular emphasis on wireless communication systems. WiRan's RF design office carries out the design of electronic devices from conception to working prototypes, including dedicated tests to ensure the required quality of the product. Its engineering team also assists customers with their EMC troubleshooting processes.

WiRan is currently undertaking two contracts for ESA concerning S- and X-band radio modules.

General information

Type of entity: **SME**

Type of activity: **production and services**

Total employment: **5**

Number of engineers and scientists: **4**

Main areas of space activity

1. Telecommunication and Navigation (GNSS)
2. Electronics



Examples of completed or on-going space-related activities

- **„Design, production and tests of an Engineering Model of S-band diplexer for CubeSat nanosatellites”** – this project, undertaken during 2016-2018, concerns the design and implementation of a laboratory prototype of a communication module - a diplexer for the S-band. The project is carried out by WiRan for ESA.
- **„Design, production and tests of an Engineering Model of cheap X-band diplexer for CubeSat nanosatellites”** – this project, in-work for the 2017-2019 period, likewise concerns the design and implementation of a laboratory prototype of a communication module – an X-band diplexer. The project is carried out by WiRan for ESA.

Laboratories, technical facilities, infrastructure

WiRan has a Radio Frequency and Microwave laboratory with a total area of 90m², with dust-free walls and ESD floor equipped with stationary network analyzers up to 8.5GHz and 43GHz, and portable up to 26GHz, a spectrum analyzer up to 43GHz, portable PIM 900MHz meter, and 3-band PIM station (900, 1800, 1900 MHz), a Climate Chamber, and a Faraday Cage.

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**RESEARCH
INSTITUTES**

Space Research Centre of the Polish Academy of Sciences (CBK PAN)



The Space Research Centre of the Polish Academy of Sciences (CBK PAN) is the only Polish interdisciplinary research institute with all essential activities focused on conducting research of near-Earth space, Solar System bodies, the usage of space technologies, and satellite techniques. One of the main goals of CBK PAN is to link the newest scientific space discoveries with daily practical applications. The Centre creates solutions and promotes the usage of satellite systems within the national economy in such areas as: navigation, telecommunications, and Earth observation. The prestige and unique character of CBK PAN can be seen in its participation in many international space missions, the construction of space instruments and research satellite subsystems, and the support of the Polish space industry through education, knowledge, and technology transfer.

Products and services offered by the Institute include:

- Space instruments – roentgen spectrometers, radio spectrometers, thermal sensors, and optical Fourier and hyperspectral spectrometers;
- Satellite subsystems – power supply systems, onboard computers, mechanical structures and thermal systems, orientation and satellite stabilization systems, communication systems, and supporting ground systems;
- Satellite navigation – precise positioning using GPS, EGNOS, and GALILEO reference stations, precise time transfer systems;
- Telecommunications – ionosonde with software, determining the status of the ionosphere based on ground observations and GPS;
- Earth observation – a semi-automatic change detection system using high-resolution photography, and terrain classification software using optical and radar photography;
- Satellite platform integration; and
- Subsystems testing.

General information

Type of entity: **research institute**

Type of activity: **production, services and research**

Total employment: **208**

Number of engineers and scientists: **90**

Main areas of space activity

- **Automation & Robotics, Space Systems Control**
- **Electronics**
- **Material Engineering**
- **Mechanics**
- **Optics and Optoelectronics**
- **Power systems and Propulsion**
- **Quality and Safety**
- **Science**
- **Space System Software: Ground Systems Software and On-Board Software**
- **Telecommunication and Navigation (GNSS)**
- **Utilization of Satellite Data, Satellite Databases**

Examples of completed or on-going space-related activities

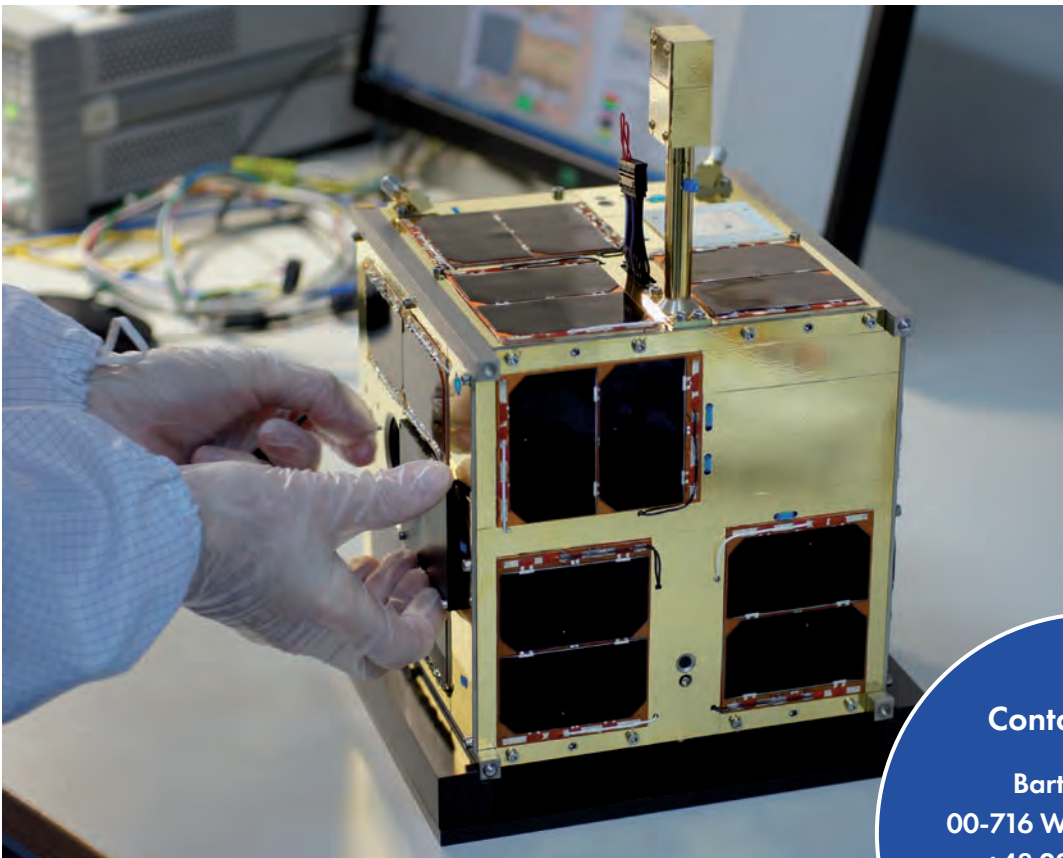
- Remote (optical and microwave) sensing of planets and other space objects (PFS/MarsExpress, MERTIS/BepiColombo);
- X-ray investigation of Sun (STIX/SolarOrbiter);
- Direct (in-situ) surface and subsurface probing of planets and small Solar System bodies with the help of penetrators and landers (ROSETTA); and
- Participation in astrophysical research (INTEGRAL gamma ray observatory), HERSCHEL far infrared ray observatory, BRITE – first two Polish scientific satellites).

Laboratories, technical facilities, infrastructure

- Electronic, optical, and mechanical laboratories with workstations for 40 persons;
- A mechanical workshop with 8 manufacturing machines (3 CNC ones);
- A vacuum chamber, environmental chambers, clean room chambers, and an EMC laboratory;
- A Ranging and Integrity Monitoring Station, an ionosonde, Time and Frequency Services, the BOR-1 station, the CBK PAN ASG-EUPOS station, and a mobile GNSS laboratory; and
- The Regional Warning Center for Space Weather.

Other

The Institute also conducts active promotional activities about the space sector in Poland and around the world; it additionally carries out expert activity for the needs of the Polish government, parliament, and local government authorities.



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Institute of Geodesy and Cartography (IGiK) Remote Sensing Centre



The Remote Sensing Centre was established in 1976. Since then, it has been conducting basic and applied research in the area of Earth Observation data application for: forestry, land use and land cover, agriculture, anthropogenic and natural changes in environment, climate change, natural hazards, etc. Currently, the Remote Sensing Centre has 25 specialists in the areas of remote sensing, GIS, programming, statistics, and project management.

The Remote Sensing Centre has significant experience in international projects, funded by the European Commission, European Space Agency, and the European Environmental Agency, as well as established cooperation with many leading research institutions and companies in the world.

The Centre additionally conducts applied research and pilot-demonstration projects for representatives of the industrial market in Poland, such as: Insurance companies (PZU S.A., Concordia), Energy sector (PGE S.A.) and for National Administration, such as: Central Statistical Office, the National Center for Support of Agriculture and the Agency of Restructuration and Modernization of Agriculture, and Polish Water (National Board of Water Management). The Remote Sensing Centre also houses a professional Computing Laboratory and equipment for in-situ measurements.

General information

Type of entity: **research institute**

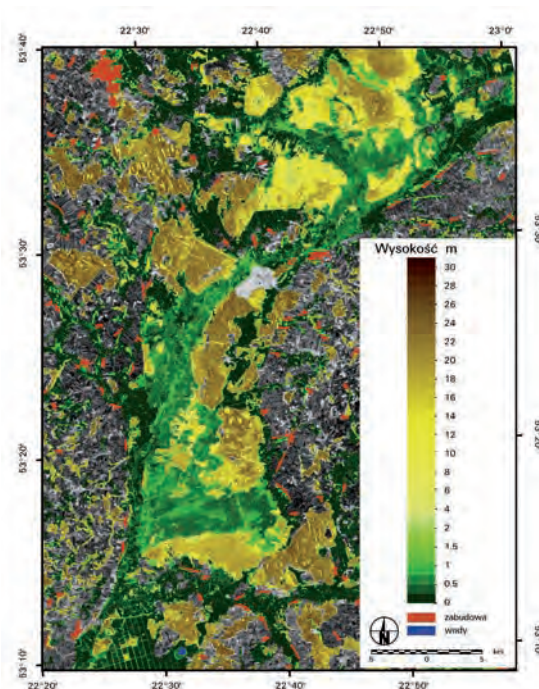
Type of activity: **services, research and science**

Total employment: **64**

Number of engineers and scientists: **30**

Main areas of space activity

- Quality and Safety
- Science
- Telecommunication and Navigation (GNSS)
- Utilization of Satellite Data, Satellite Databases
- Education and Publicity



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Examples of completed or on-going space-related activities

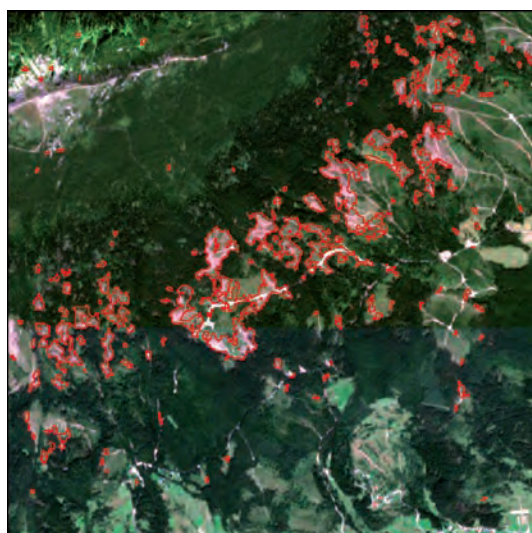
- **„Irrigation Factor 4 potato growth using Sentinel1 and Sentinel2 data (IRRSAT)”** – the aim of the project is to develop the model for soil moisture assessment as part of the effort to estimate the watering dose for agricultural plants.
- **„Service 4 Drought - Drought Monitoring applying Satellite data”** – the project is focused upon development and validation of a system for drought assessment based on the synergy of satellite and meteorological data, as well as establishing an Internet Platform, enabling users from sectors such as agriculture, energy, and water management seeking methods to prevent and mitigate activities related to drought.
- **„SAT4EST - Earth observation based service supporting local administration in non-state forest management”** – the main aim of the SAT4EST is to design and build a non-state forest focused service for dedicated use by local government administration in Poland. The EO-based service will provide a simple, intuitive, and low-cost tool in the form of a web-based, easy-to-use application which is expandable for other datasets.
- **“Service for Agriculture - ASAP - Advanced Sustainable Agricultural Production”** – this project is directed at development of a satellite data-based System and Service for agriculture, in the form of web and mobile applications.
- **„GyroScan – Elaboration of innovative method of monitoring the state of the agrocenosis with the use of remote sensing gyro system in terms of precision farming”** – the aim of the project is to develop a Decision Support System based on remote sensing data and methods for precision farming (for determination of needs for agricultural practices).

Laboratories, technical facilities, infrastructure

- Computer Laboratory for satellite data processing equipped with several servers, workstations and software packages, and specialized software;
- access to Okeanos Supercomputing CrayXC40;
- professional instrumentation for remote in-field measurements; and
- databases of satellite data: NOAA AVHRR, Terra MODIS, Landsat TM, Sentinel-1/2/3.

Other

IGIK plays a key role in the EIONET National Reference Center (NRC) for land cover. IGIK is responsible for production of the national CORINE land cover databases and for verification of the Copernicus Land Monitoring service components.



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Institute of Aviation (IoA)



The Institute of Aviation (IoA) is the largest Polish R&D centre dedicated to aeronautical and space engineering. It has a wide portfolio of aircrafts, helicopters, and rockets. IoA cooperates with, inter alia, the European Space Agency, General Electric, Pratt & Whitney, Thales Alenia Space, Airbus Defence & Space, Lockheed Martin, and Rolls Royce. IoA actively participates in European research programs. In recent years, this has included EC programs such as FP (5-7) and Horizon 2020, as well as ESA programs, including: PECS, the Polish Industry Incentive Scheme, TRP, GSTP, GSP, and Clean Space.

IoA develops technologies for environmentally-friendly propulsion systems. Among these is a patented technology of obtaining high-concentration, high-purity hydrogen peroxide for rocket propulsion. In addition to satellite thrusters, IoA develops solid rocket motors for deorbiting spacecraft. IoA also works on suborbital and launch vehicle technologies. As a result of IoA's work on the hybrid ILR-33 "Amber" rocket, conducting microgravity experimentation is possible. Beyond its advanced efforts on various propulsion systems, IoA has ongoing work on remote sensing activities and data analysis.

General information

Type of entity: **Research institute**

Type of activity: **production, services, research and science**

Total employment: **1276**

Number of engineers and scientists: **1027**

Main areas of space activity

- Automation & Robotics, Space Systems Control
- Mechanics
- Power systems and Propulsion
- Structures
- Utilization of Satellite Data, Satellite Databases



Examples of completed or on-going space-related activities

- **Development of ILR-33 “AMBER” rocket** – a key project of the Center of Space Technologies of the Institute of Aviation. The primary initiative is to demonstrate key technologies for modern suborbital rockets and small launch vehicles. “Amber” is a highly-scalable, cost-effective, and green platform enabling the conduct of experiments in microgravity at altitudes of up to 100 km. Moreover, ILR-33 “Amber” is the world’s first sounding rocket that utilizes hydrogen peroxide in a concentration exceeding 98%.
- **„Green hypergolic 5 kN bipropellant rocket engine development”** (NCBiR*) – the main objective of HIPERGOL is to develop a rocket engine demonstrator with a hypergolic ignition propellant, which would be both liquid and non-toxic. The technology will be used in both sustainer engines of launch vehicles, as well as in their final stages. The project is being carried out at the Institute of Aviation in the Center of Space Technologies.
- **„Pre-qualification of Aluminum-free Solid Propellant”** (ESA) – as part of the project, a solid propellant is being developed to meet the requirements for deorbit propulsion. In addition to the development, tests, and initial qualification of the propellant, the initial assumptions for the design of the engine itself are also analyzed.
- **„50 kN solid rocket booster development”** (NCBiR*) – the forecast result of this project is the development of rocket motor demonstrators in two versions, differing in material used for the design of the combustion chamber (metal and composite chamber). The primary aim of the project is to acquire competence in the design and manufacture of this type of construction, both for civil and military applications.
- **„Green bi-propellant apogee rocket engine for future spacecraft – GRACE”** (ESA, PLIIS) – the aim of this project is to carry out numerous trials of an LAE (Liquid Apogee Engine) technology rocket demonstrator designed to transport a satellite from low (LEO) to geostationary (GEO) Earth orbit.

*Project co-financed by the National Center for Research and Development as part of the agreement on completing and financing the project implemented for security and defence of the country within call no 8/2016.

Laboratories, technical facilities, infrastructure

Test bench for rocket propulsion systems with: PXI data acquisition, fast cameras and thermovision; Hydrogen Peroxide Laboratory; Catalyst and Propellant Laboratory; high-speed wind tunnels; Non-Destructive Testing Laboratory; Environmental Laboratory (shaking apparatus, vacuum chambers, etc.); Laboratory of Spectral Signatures; GIS laboratory; Photogrammetry laboratory.

Other

The Institute of Aviation is the regional leader in rocket and space propulsion. IoA is involved in 9 out of 11 ESA projects dedicated to rocket propulsion in Poland. It also has at its disposal a complete technical infrastructure for acquiring, processing and distributing aerial and satellite data.

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Institute of Electronic Materials Technology (ITME)



The Institute of Electronic Materials Technology is a research, development, and consultative institution offering a unique combination of scientific and technological capabilities. ITME is recognized for its comprehensive and interdisciplinary research in the fields of materials engineering, electronics, photonics, optoelectronics, environmental engineering, chemical technology, and nanotechnology.

The Institute's research in the field of materials engineering is carried out on advanced, new-generation materials, including two-dimensional materials, such as graphene. Technologies for producing materials are being developed, as are their applications in electronics, photonics, aerospace, automotive, and other sectors.

ITME R&D activities include: materials for next-generation components (graphene, self-organizing materials), materials for photonics, components (optical fibres, filters, diffractive lenses, two-dimensional photonic microstructures), semiconductor devices (lasers, transistors, photodetectors, Schottky diodes), and solid lasers, microlasers.

General information

Type of entity: **research institute**

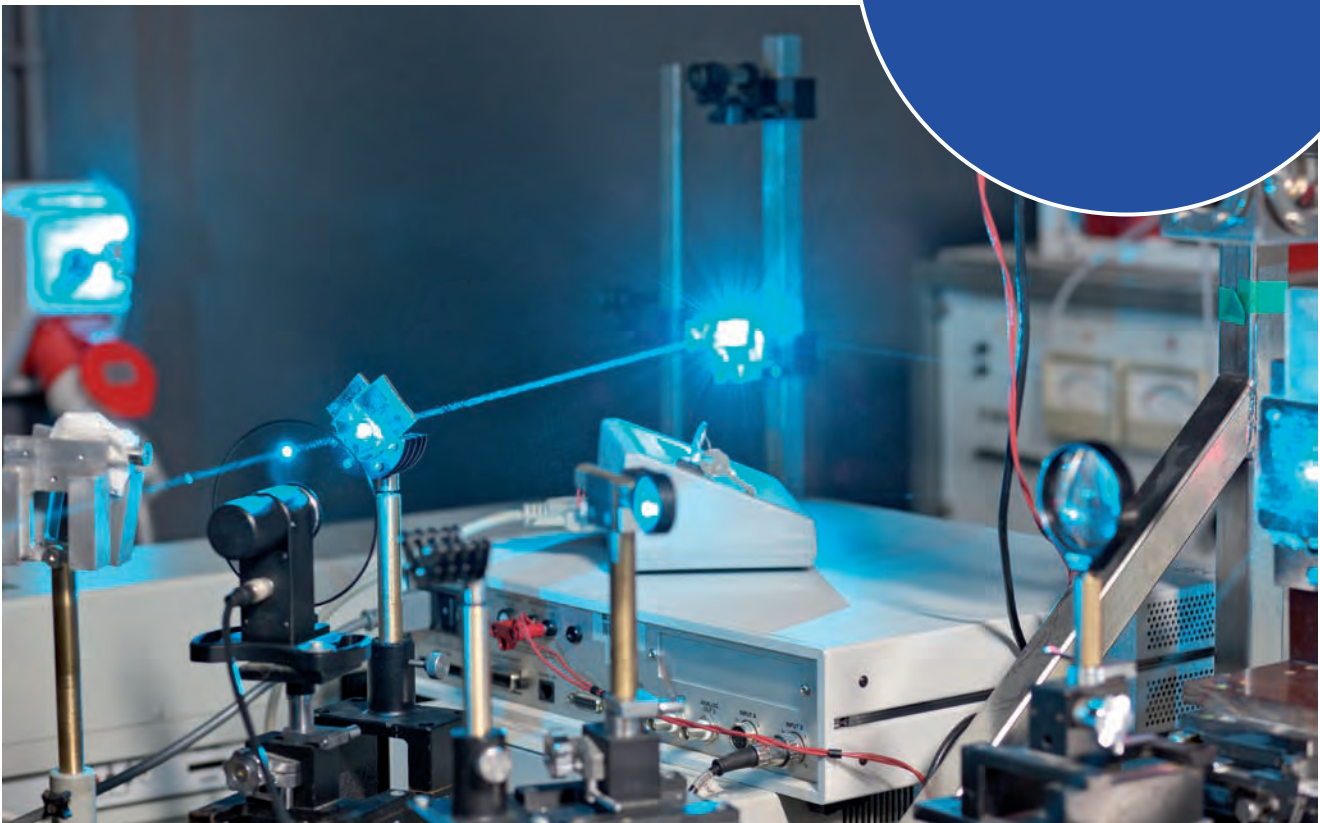
Type of activity: **production, services and research**

Total employment: **238**

Number of engineers and scientists: **142**

Main areas of space activity

- Electronics
- Material Engineering
- Optics and Optoelectronics



Examples of completed or on-going space-related activities

- **„Lightweight compact optical system based on DOE and aspherical elements”** (ESA) – consortium of the project: Solaris Optics S.A. (leader), Space Research Centre of the Polish Academy of Sciences, and ITME. The main objective of the project is to design, manufacture, and test a compact telescope based on diffractive optical elements (DOEs) and aspherical surfaces. ITME’s role is the design and fabrication of DOEs, which will be used to limit chromatic aberrations in the optical system, and at the same time to reduce its mass and dimensions.
- **„Self-organization approach towards photonics/optoelectronics”** (TEAM – PO IG) – the goal of the project was to obtain new materials with special electromagnetic properties that could be used in photonics and optoelectronics, especially when exploiting metamaterial and plasmonic phenomena effects in bulk materials. The result of the project was the development of technology for the production of voluminous nanoplanidic materials.
- **„Hybrid semiconducting materials for solar energy conversion”** (Polish-Swiss Research Programme) – the aim of the project was development of innovative materials that would effectively split water into hydrogen and oxygen under sunlight irradiation. Researchers have succeeded in creating a new class of hybrid semiconductor materials, which are very efficient in absorbing sunlight that can be used in next-generation solar cells.
- **„Engineered self-organized multi-component structures with novel controllable electromagnetic functionalities”** (ENSEMBLE – 7 PR) – an international project (7 partners from 5 countries) coordinated by ITME. The project’s objective was research on obtaining new materials for photonics/optoelectronics, testing the possibility of using self-organizing structures to create metamaterials for photonic applications.
- **„Eutectics and metamaterials at a crossroads”** (HARMONIA – NCN) – the project focused on research on creating new self-organized materials with special electromagnetic properties, by using directional crystallization of eutectics.

Laboratories, technical facilities, infrastructure

The institute has facilities for production and characterization of materials, including laboratory equipment (SEM, XPS, SIMS, Raman), as well as equipment for epitaxy including instruments for optical, microscopic, and electrical characterization. The Mask Laboratory offers E-beam and Nano Imprint Lithography (chrome photomask, direct E-beam pattern writing, and diffractive optical elements).

Other

The ITME team is carrying out more than 60 scientific projects, including 12 foreign projects, such as Graphene Flagship and ENSEMBLE³/H2020. Its scientists are also authors of over 50 patents and dozens of patent applications, including graphene technology.



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Tele & Radio Research Institute (ITR)



The Tele & Radio Research Institute (ITR) is a first-class research institute pursuing comprehensive and multidisciplinary research and development activities on highly-developed technologies and innovations having viable prospects for implementation in many industries. The Institute is a body identified by the European Commission number 1941. The Institute's essential research areas relate to selected electronic materials and components, electronic mounting and specialized ICT systems. The Institute's mission is accomplished by conducting scientific and research work, applying such efforts, and preparing them for implementation on an industrial scale. Such efforts are carried out by specialized Centres. The Institute has implemented, maintained, and improved a Quality Management System compliant with the PN-EN ISO 9001:2009 standard.

The basic goals of ITR's activity include:

- implementation of key tasks in the national and European innovation system through comprehensive interdisciplinary research and development;
- creating new solutions in the field of electronics and transforming them into innovations for business entities; and
- concentration of the Institute's activities on research and development projects of a technological and IT nature, playing a key role in meeting the needs of modern economy.

General information

Type of entity: **research institute**

Type of activity: **production, services, research and science**

Total employment: **191**

Number of engineers and scientists: **126**

Main areas of space activity

- **Automation & Robotics, Space Systems Control**
- **Electronics**
- **Material Engineering**
- **Quality and Safety**



Examples of completed or on-going space-related activities

ITR is a participant in the ESA-PLIIS projects, as well as in local projects financed by the Minister of Science and Higher Education and in projects supported by EU H2020. The laboratory accredited under 17025 is in the process of becoming one of the ESA-listed labs.

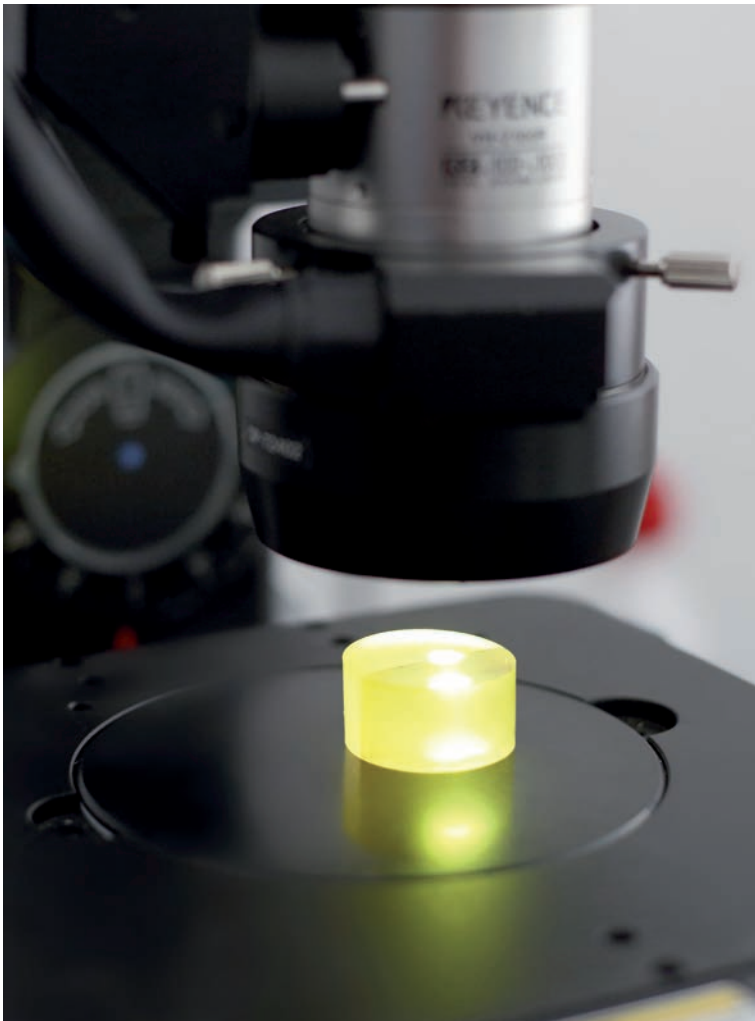
Laboratories, technical facilities, infrastructure

ITR has highly-equipped facilities for PCB production and assembly of PCBAs. It also has facilities for manufacturing of special ultrasonic and vacuum equipment. The Laboratories are accredited and are identified as ABO45 and AP009, performing validation for the automotive industry, building vacuum apparatus, and performing vacuum tests. Among other activities, the Laboratories are engaged in the following research:

- environmental tests;
- analysis of solder joints by non-destructive methods, such as microscopic observation and X-ray (including laminography and computed tomography CT); and
- analysis of cross-sections by use of optical and electron microscopy (SEM), with the potential for whiskers observation.

Other

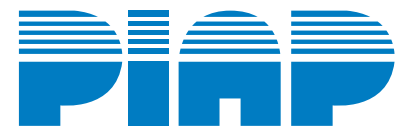
ITR, as one of the leading scientific and research units in the fields of electronics, ICT, vacuum, and ultrasonic research, offers innovative and modern technological, design, and IT solutions based on the most recent scientific and technological achievements focused on meeting customer's needs.



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Industrial Research Institute for Automation and Measurements PIAP



Industrial Research Institute for Automation and Measurements PIAP is a leading research unit in Poland, established in 1965. The Institute develops innovative technologies in the following fields: automation and robotization of production lines and factories, mobile robotics for security, 3D printing, as well as for space industry applications. PIAP's researchers conduct basic research and R&D projects. With numerous successes to its credit, PIAP commercializes research results and sells products – notably including counterterrorist mobile robots – in Europe, Asia, and Africa.

PIAP is active both upstream and downstream in the space sector – it develops robotic devices for servicing and exploring space, and MGSE (Mechanical Ground Support Equipment), as well as technological devices for testing and integrating satellites. The Institute also offers satellite-based navigation services that are resistant to interference. PIAP additionally develops robotic components for the space sector. The projects and orders are carried out by interdisciplinary teams of experts from the Mobile Systems Division, Satellite Systems Laboratory, and PIAP Space, a spin-off company established in 2016.

General information

Type of entity: **research institute**

Type of activity: **production, services, research and science**

Total employment: **292**

Number of engineers and scientists: **173**

Main areas of space activity

- Automation & Robotics, Space Systems Control
- Quality and Safety
- Space System Software: Ground Systems Software and On-Board Software
- Telecommunication and Navigation (GNSS)
- Utilization of Satellite Data, Satellite Databases
- Education and Publicity



Examples of completed or on-going space-related activities

- **Evaluation of Galileo/EGNOS services jamming incidence in Central Europe (ESA)** – The project's result is a remotely-controlled mobile interference-detection and identification system (mobile test bed). The system is used to conduct research on the principal transport corridors of Central Europe.
- **SAFETRIP "Satellite Applications For Emergency Handling, Traffic Alerts, Road Safety and Incident Prevention"** – PIAP was involved in the development and testing of innovative tools to enhance transport safety on European transport corridors.
- **"PACIFIC Applications Concept Involving Future Interested Customers"** – PIAP participated in the analysis and identification of needs and expectations of future users of the GALILEO Public Regulated Service.
- **TALOS "Transportable Autonomous Patrol for Land Border Surveillance System"** – PIAP was the leader and prime contractor for a multidisciplinary project for the development, implementation, and field-testing of an innovative, mobile, scalable, autonomous TALOS system for the surveillance of the European Union's land borders.
- **SARBACAN "SearchAndRescue BeAcon development with CANada"** – PIAP participated in the development of a new receiver with automatic confirmation of alarm reception, as well as in the analysis of the demand for new receivers (beacons) in Central Europe.

Laboratories, technical facilities, infrastructure

The Satellite Techniques Laboratory (STL) performs the following tasks:

- study of the wide spectrum of near-terrestrial radio signals and distant space radio signals;
- research into the quality and reliability of GNSS positioning, based on GALILEO, GPS, GLONASS, and SBAS services for mobile and static systems, and ultimately on GALILEO PRS;
- research in the field of satellite communication, including fully-developed technologies, as well as solutions for use in amateur radio services;
- studies on threats from intentional and unintentional radio interference to critical infrastructure, including navigation systems, precision timing systems, border infrastructure, and transport;
- research in the field of satellite cryptography, and use of quantum cryptography for secure satellite communication.

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