SPACE PL
Polish Space Industry Association

The Polish Space Industry Association Members Catalog

2021

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The Polish Space Industry Association

The Polish Space Industry Association [the SPACE PL] **is the only organization that represents the interests of employers of the space sector in Poland.** The organization was established in 2012 and currently associates **over 70 entities**. It includes large, medium, and small enterprises as well as research and development institutes that operate in the space sector. They provide products and services to institutional and commercial customers in the country and abroad.

The space sector is one of the most advanced and innovative sectors that is increasingly important to the economy and society. The SPACE PL wants to use the technological advances resulted from the implementation of space projects to benefit the Polish administration, citizens, and the economy in the best possible way.

Hereby, the SPACE PL strives for the right framework for the Polish space sector development. It conducts a dialogue with the government, public administration, and other institutions involved in the implementation of the national space policy. It takes part in the consultations of crucial normative acts, programs, and solutions for the sector. The Association works towards creating the best regulatory environment as well as efficient structural and business solutions that can strengthen the space sector in Poland.

Moreover, **the SPACE PL conducts the activity aimed at increasing the Polish participation in the European Union space agenda, the European Space Agency** missions as well as the space projects of **the European Organization for the Exploitation of Meteorological Satellites** and **the European Southern Observatory**. It initiates and organizes meetings with business partners in the country and abroad. It acts as an intermediary in the exchange of information about projects and new business development opportunities.

The SPACE PL actively promotes the Polish space sector. It participates in the most important industry conferences or fairs organized in the country and abroad promoting its members. The Association is the organizer of **the Space Sector Forum**, the largest Polish conference combined with an exhibition for the space industry in the country.

The Polish Space Industry Association supports the development of human resources and their competencies. Together with ARP, **it organizes the internship program entitled "Development of human resources in the space sector"**. The program aims at attracting and recruiting interns for our entities. The SPACE PL is a member of the Sectoral Competence Council of the Aviation and Space Industry at PARP, the Lewiatan Confederation and other international organizations such as SME4Space. In the previous years, the Association implemented projects financed with the funds allocated to clusters in the EU Horizon 2020 program. It allowed our members to finance the research dedicated to new products and services.

The SPACE PL is a member of the LEWIATAN CONFEDERATION and SME4SPACE.

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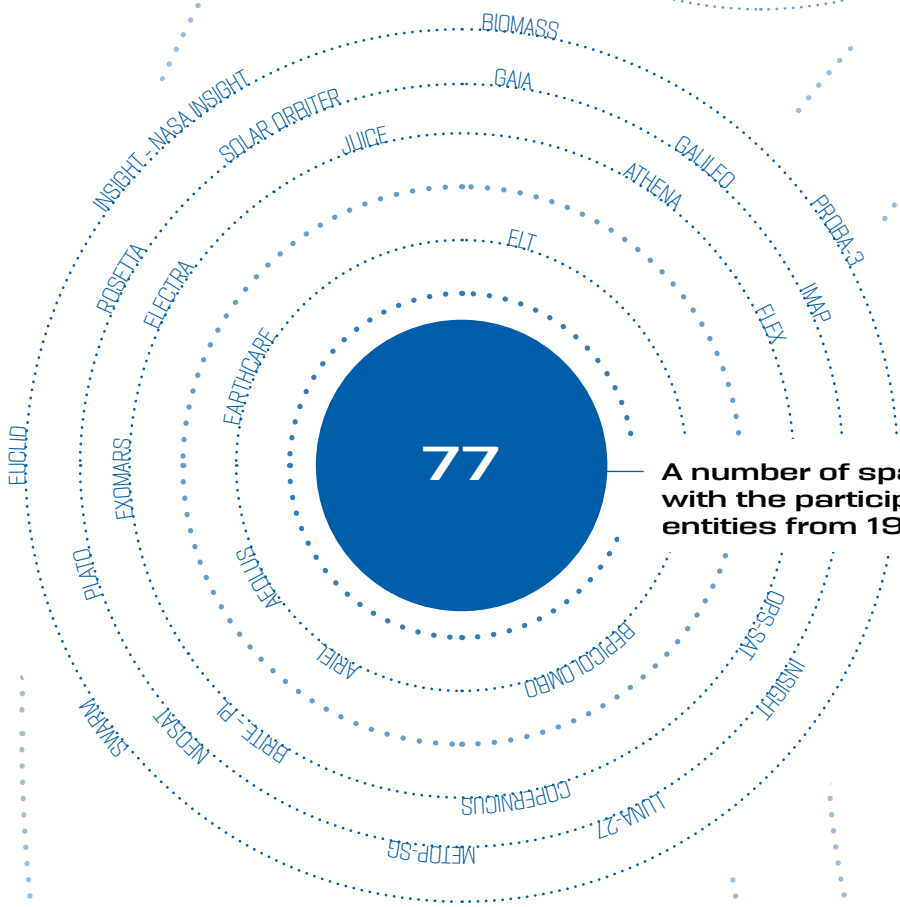
LEWIATAN

SME4SPACE

Total employment in the SPACE PL entities

ca.
6000
employees



A number of space missions with the participation of the Polish entities from 1970 to 2020

Revenue generated in total by the SPACE PL members annually

ca. **1.8 mld** PLN

94.2 mln euro

Total value of the Polish entities contracts acquired from ESA between 2014-20

A number of members of the SPACE PL

72 entities, including:

27 micro-enterprises

22 small companies

10 large companies

7 medium enterprises

6 R&D institutes

Index

6ROADS Sp. z o.o.

6ROADS is highly specialized company focused on solutions for satellite business and planetary defense. The infrastructural core of 6ROADS is the network of seven optical observatories located across the globe.

– Chile, San Pedro de Atacama, MPC-W98, Polonia Observatory

– Namibia. Tivoli, MPC-L80, Springbok Observatory

– USA (NM), Beata Observatory

– Spain, Nerpio, MPC-Z33, Idgrasil Observatory

– Italy, Carpineti, MPC-D03, Rantiga Observatory

– Poland, Cracow, MPC-B63, Solaris Observatory

– Poland, Oborniki, MPC-K98, Oborniki Observatory

The system of optical sensors allows for systematic surveillance and tracking of known and searching for unknown or lost objects: artificial (satellites and space debris) and asteroids.

With our observatories 6ROADS has full access to northern and southern hemisphere. Our observatories are able to work 24/7 and only limiting factor is sun and weather.

Access controlled office, tripled (in case of problems) internet connections, satellite phones and industrial grade computers makes our infrastructure rigid and ready for future challenges. Furthermore an organizational structures like SPOC and internal SOPs make 6ROADS a professional partner.
First 6ROADS observatory was made in 2003 and our observatories are among first automated assets in Poland. Since that time we have implemented great number of unique solutions for automation and reduction of obtained data. Today with more than fourteen years of experience we are managing our assets in most distant locations, night after night, sometimes under very difficult conditions. Our activity in projecting, building and software&automatics integration allow us to effectively manage remote astronomical observatories. The 6ROADS has theoretical and practical knowledge in telescope maintaining, collimation and sensors performance. Moreover, a large number of minor planet and comet observations and discoveries made by 6ROADS team confirms our knowledge and proficiency in planetary astronomy.

Today the interest of 6ROADS team is mainly focused on Space Situational Awareness, especially SST and NEO observations. Longterm cooperation with universities and scientific centers give us instant insight in most recent research and trends in this field.

Products and services

– Observations of man-made objects in space with ground based network of optical telescopes.
– Observations of natural objects in space with ground based network of optical telescopes
– Astrometry of objects allowing further analysis and orbit determination
– Activity in frames of widely understood SST (Space Surveillance and Tracking)

Clients and Partners

– European Space Agency
– Polish Space Agency
– EU-SST Consortium
– ITTI Ltd. Poznan
– GMV ltd.
– Adam Mickiewicz University
– Swiss Federal Institute of Technology Zurich
– University of Zurich
– University of Western Sydney
– Okapi Orbits
– Sybilla Technologies
– Space Research Centre of Polish Academy of Sciences
– Nicolaus Copernicus Astronomical Center of Polish Academy of Sciences

Adaptronica Sp. z o.o.

ADAPTRONICA is an SME of R&D profile, providing consulting services, offering products and doing research related to the field of smart technologies.

Smart technologies encompass interdisciplinary technological solutions including elements of mechanics, electronics and vibroacoustics. The solutions are based on smart materials, e.g. piezoelectric or magnetostrictive materials, magneto-rheological fluids, etc., in terms of hardware and on up-to-date or self-developed analyzing and control algorithms in terms of software. Applications of smart technologies allow for a radical increase of the reliability of engineering structures, e.g. airplanes, railway vehicles, bridges, etc., during their lifetime on the one hand and for preserving their integrity in extreme conditions on the other. This goes in parallel with the requirements of safety engineering.

ADAPTRONICA is a spin-out SME, having its roots in the Institute of Fundamental Technological Research of the Polish Academy of Sciences (IPPT PAN) in Warsaw. The majority of its staff are young and highly-qualified engineers, strongly motivated to implement their technological ideas for the benefit of various industries. Most of our team are experts holding PhD degrees in various fields of engineering.

Products and services

Services:
structural health monitoring, damping of noise and vibration, vibroacoustic measurements, environmental acoustics, tests of dissipation of impact energy

Products:
vibration damping systems (in-house), weigh-in-motion systems (in-house), structural health monitoring systems (in-house), piezoelectric actuators (Cedrat), FEM software (Cranes Software).

More information:

Areas of activity in the space sector:

structures and pyrotechnics, damping of vibrations including microvibrations, shock attenuation, software development

Space sector projects:

– European Space Agency project - (2014-2016) - Shock absorbers for an application on scientific spacecraft, 4000109463
European Space Agency project - (2015-2017)
- Active vibration cancellation with proof mass actuators for cryo-coolers, 4000113621

Research and development areas:

damping of vibration, shock attenuation, vibroacoustics, structural health monitoring

Laboratories and technical facilities:

– Vibroacoustic laboratory of 100 m^2 including
– unique 2D drop test stand
– electromagnetic shaker of high power
– laser Doppler vibrometer by Polytec
– multi-channel data acquisition and analysis system by Bruel&Kjaer
– acceleration sensors by Bruel&Kjaer
– other sensors e.g. displacement, strain, temperature
– sound level meters by Bruel&Kjaer
– piezoelectric actuators by Cedrat
– multi-channel data acquisition and control system by National Instruments
– oscilloscopes, amplifiers, signal generators, measurement accompanying electronics

Agencja Rozwoju Przemysłu S. A. (ARP S. A.)

Industrial Development Agency JSC

Agencja Rozwoju Przemysłu S.A. (Industrial Development Agency JSC - ang.) belongs to the Polish Development Fund Group. (the PFR - pol.) The ARP cooperates with major Polish institutions supporting enterprises and provides compre-hensive solutions in response to the current needs and challenges faced by businesses. The ARP supports enterprises in operation and development of business activities, as well as in the implementation of restructuring processes, and plays a major role in increasing competitiveness of the Polish industry.

For over 25 years, the ARP successfully attracted Polish and foreign investors to the Special Economic Zones it manages, where the following industrial parks operate: EURO-PARK Mielec, EURO-PARK Wisłosan and EURO-PARK Kobierzyce. The ARP supervises several dozen companies doing different businesses, including two companies from the space sector: Creotech Instruments JSC and PIAP Space Sp. z o.o.

The ARP also offers a dedicated support programme for the space technology sector. The programme is in line with the ARP overall view of support for the space industry, as not only being the means of space exploration, but also as a source of innovation and applications for other areas of the economy. The ARP supports space technology sector programme by:

– Developing an internship scheme called "Human Resources Development in Space Technology Sector", in association with the Polish Space Industry Association (the SPACE PL). The programme is dedicated to graduates and young scientists who can learn practical skills working for the Polish companies from the space sector. The ARP has already carried out four editions of the programme for 43 trainees, who completed their 6-month internships in companies associated in the SPACE PL. Within the programme, the ARP covers up to 50% of the trainees' remunerations. The 5th edition of the programme is now in progress. In total, since the first edition, we have received over 400 applications.

– The ARP is a leader of the consortium for the establishment of the European Space Agency Business Incubation Centre in Poland (ESA BIC Poland). The ESA BIC is a network of business incubators coordinated and co-financed by the European Space Agency. The incubators are to support start-ups or newly created companies. In 2021 the ARP together with its 5 partner cities, Gdansk, Krakow, Rzeszow, Warsaw and Wroclaw, is planning to start recruitment for the first incubators.

– the ARP offers dedicated line of credit. It's a financial product designed for businesses operating within the space technology sector and cooperating with national or international organisations working area of space explo-ration and subcontractors in the exploitation and/or their (e.g. ESA, GSA, EDA, national agencies as well as PRIME companies).

– the ARP provides spectiraalisntin g under the name of the ARP Spa Acceademy.

– the ARP carries out a number of projects promoting the space sector and initiating cooperation with other sectors, including large companies. These are, among others:

– Co-financing of the Polish stands at foreign trade fairs;

– Organisation of the Satellite Forum 2017;

– Organisation of the European Space Tech Transfer Forum in 2019;

– Reunions of YGT ESA graduates.

Airbus Poland S.A.

Airbus after establishing an initial presence in Poland in 2001, continues to expand its profile while building on a century of Polish aviation heritage. Airbus' long-term commitment to the country is visible through a scope of activities ranging from design, prototyping, manufacturing, maintenance, upgrades, research and development, exchange of technology, to cooperation in the space industry. The company employs nearly 1,000 high-skilled workers in Poland at three locations: Warsaw, Mielec and Lodz.

Starting from 2015, there is a 500 m2 Clean Room in Airbus Poland in Warsaw, concentrating activities for the space industry.

Activity in Airbus Poland S.A.

In 2015, Airbus Poland S.A. established a Space Commercial & Program Department to initiate production activities in the space sector. The core business of the department includes electrical harness and MSGE design, manufacturing, testing and integration. The development process of electrical harness covers all phases from concept, design and manufacturing performed on the 3D Mock-ups (MGSE). Scope of tests covers visual inspections, retention and tensile strength tests, electrical insulation, continuity and resistance tests (Kelvin method). Company is providing services to integrate own products on spacecraft structure. Airbus Poland S.A. built a 500 m2 cleanroom it the facility in Warsaw providing ISO 8 and 7 cleanliness class. Cleanroom is dedicated for manufacturing of spaceflight components, MGSE and spacecraft integration. In the future production of telecommunication satellites is foreseen.

Currently Airbus Poland S.A. provides 7000 to 9000 electrical harness annually for our customers and group programs. Our company manages projects for design and manufacturing of the electrical harness, supplying principally the Airbus entities and the European Space Agency (ESA), German Aerospace Center DLR, Swedish Institute of Space Physics IRFU.

Delivered Projects:

- MetOpSG (EFM, flatsat)
- MetOpSG T-adaptors (connecting hardware with EGSE)
- JUICE (platform harness, EM)
- JUICE (platform harness, PFM)
- JUICE (CPS, platform harness, PFM)
- JUICE RPWI (instrument harness, EM)
- JUICE RPWI (instrument harness, QMR)
- JUICE RPWI (instrument harness, QM)
- JUICE RPWI (instrument harness, FM)
- JANUS, JUICE (instrumental harness)
- Biomass RIU test harness (for EMC testing)
- Biomass (XDA harness, PFM)
- AIT Development in APL including harness installation demonstrator to ESA
- Qualification (shadow manufacturing)
- Biomass (hinge harness demonstrator)
- Biomass (SM, structural harness)
- Biomass (RCS SM test harness - planned delivery August 2020)
- Biomass (PFM - electrical harness - planned delivery December 2020)

Innovation

Airbus Poland S.A. is constantly looking for ways to improve production and introduce innovations that can improve the quality of products offered to customers. In 2019, Airbus Poland S.A. began cooperation with start-ups under two programmes: Future Space Accelerator and Spark 2.0. In scope of the ESA Polish Industry Incentive Scheme project Airbus Poland is also developing manufacturing capabilities for specialized space harness manufacturing to expand current portfolio of the company.

Commercial and Defence Aircraft

At the Okecie district in Warsaw, Airbus Poland S.A. runs a design office, production plant and MRO (maintenance, repair and overhaul) center providing services to the C295 fleets of Poland, Czech Republic and Kazakhstan. Due to th company's industrial commitment and information-sharing, some 40% of airframe components in all C295 aircraft sold globally are produced there. Furthermore, about 70% of all electric harnesses for the transport aircraft manufactured by Airbus are manufactured at Okecie. The factory in Warsaw also is responsible for the production of aerostructures, components and systems for A320 and A330 Family airliners - contributing significantly to Airbus global supply chain. Moreover, engineers from Okecie have designed and developed PZL-130 Orlik aircraft for basic and advanced training of military pilots.

In Mielec Airbus Poland operates a fleet of 39 aircraft that perform a variety of duties, including surveillance and firefighting. The Department of Aviation Services (WUL), also located in Mielec, is responsible for training pilots and ground crews, as well as sale of aircraft and parts.

Antmicro Sp. z o.o.

Antmicro develops and integrates embedded software and technologies for various branches of industry and the emerging ecosystem of the Internet of Things (IoT). The company provides comprehensive R&D services for customers across the globe (i.a. the US, EU, Switzerland, Singapore and Australia) in applications from robotics, drones, defence and civil security to portable broadcasting and medical devices.

With cross-competence in software, full-stack FPGA SoC and high-end hardware, Antmicro develops new products for edge computing and encourages customers to adopt modern embedded solutions, including open source and open hardware technologies like Linux, FreeBSD, Android, RTEMS, Contiki-NG, Zephyr, OpenRISC, LEON and RISC-V. Antmicro is an original Founding Member of the RISC-V Foundation, introducing an open Instruction Set Architecture for a new era of processor innovation through open standard collaboration with companies such as Google, NVIDIA or Tesla.

Products:

- Renode, an open source software development framework for simulating multi-node IoT systems
- Antmicro TX2 Deep Learning Platform, an embedded GPGPU 6-camera setup based on the NVIDIA Jetson family for AI applications in robotics, drones and in-field operations
- Antmicro UltraScale+ Processing Module, an embedded platform for the Xilinx Zynq UltraScale+ FPGA SoC targeted at high-speed video processing
- Reference platforms for various heterogeneous CPU solutions, both ARM and RISC-V based (also with built-in PL) e.g. Xilinx Zynq/UltraScale+, NXP Vybrid/i.MX, Microsemi and Intel FPGA/FPGA SoC

Services:

- Hardware and full product design, baseboards, camera boards
- Software design, BSPs, drivers, update systems, buildsystems
- GPGPU / FPGA processing, AI, vision processing, data fusion algorithms
- Full-stack FPGA SoC development
- Embedded systems development powered by RENODE: building customized tools, user interfaces and integrations, setting up CI
- Early adoption of RISC-V: PoC, prototyping, hardware, porting OS, drivers, buildsystems, custom FPGA peripherals & integration

Areas of activity in the space sector:

On Board Data Systems
Space Systems Software
Space System Control
System Design & Verification
Ground Station System and Networks
Automation, Telepresence & Robotic

Main space industry projects:

Antmicro develops operating system software, drivers, feasibility studies, simulation and verification in work packages related to the development of on-board space mission computers, fault tolerant real time systems, industrial satellite modems, SPA, precise timing, video processing.

Research & development projects:

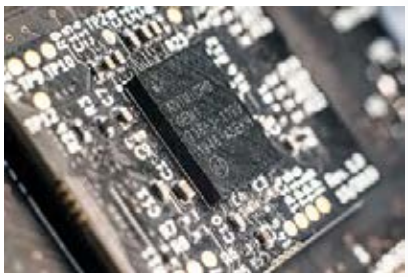
systems integrating embedded technologies and FPGA
new CPU technologies, including multicore and heterogeneous architectures
emulation/simulation/modelling of embedded systems and processes
Internet of Things
video processing technologies

Laboratories and technical facilities:

Antmicro's campus is located in Poznan's city center and spans across two buildings - the historic Concordia Design and the modern Baltyk office tower. With ca. 400m2, the campus includes office space, programming rooms, an electronics design lab and conference rooms.

Clients and partners

Xilinx
Nvidia
NXP
Microsemi
Intel
Thales Research and Technology
RUAG
SICS
Toradex
Enclustra
STMicroelectronics



Astri Polska Sp. z o.o.

Astri Polska is a leading company in the Polish space sector. It specialises in the field of electronics and space applications and services. The company is the principal Polish participant in programmes implemented by the European Space Agency. It also delivers dedicated solutions to the European Commission (European GNSS Agency, European Environmental Agency, Horizon 2020), the World Bank, the Polish National Centre for Research and Development, and other customers.

The company portfolio includes approx. 50 projects concerning development of space tech- nologies for i.e.: ESA, European Commission (FP7, BONUS, ENIAC, Horizon 2020) and Polish National Centre for Research and Development (NCBiR). It delivers solutions to leading European space programmes, such as JUICE, MetOpSG, Sentinel-5, NeoSat, EUCLID. 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 is appointed Copernicus Relay an official partner of Copernicus programme in Poland.
Astri Polska is a Joint Venture of Airbus Defence and Space and Space Research Centre of Polish Academy of Sciences (CBK PAN). Since foundation in 2010, the company is growing rapidly, employing approx. 80 people, mostly Polish engineers. Astri Polska activities are in line with priorities of Polish Space Strategy.

Products and services

Products:
– Electronic ground support equipment for satellites
– Optomechatronic ground support equipment for satellites
– Test environments for space-grade GNSS receivers
– Test environments and algorithms for hybrid navigation (GNSS+LTE)
– GNSS devices production
– Applications and services based on space technologies

Services:
– GNSS space-grade receivers testing
– Satellite EO data processing (optical and radar)
– Distribution of Airbus Defence and Space satellite imagery and geoinformation products Advisory in satellite technologies
– Crisis Management/Safety training

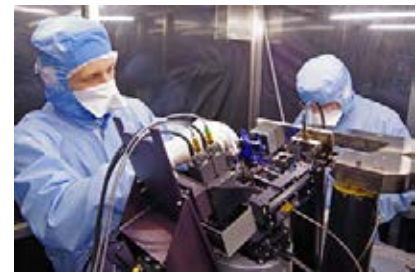
Additional information

Space sector projects:

– JUICE - electronic ground support equipment for JUICE probe and digital simulation models (ESA)
– MetOpSG - electronic ground support equi- pment for MetOpSG (second generation) satellites and digital simulation software (ESA) NeoSat - electronic ground support equi- pment for Eurostar Neo satellites (ESA) UV2VIS - Optical ground support equipment for SENTINEL-5 satellite
– AGGA-4 - Test environment for AGGA-4 integrated circuit of space-grade GNSS (ESA) FLIGhT - test environment for space-grade GNSS receivers (ESA)
– TEcHNO - test environment and algorithms for hybrid navigation (GNSS+LTE) (ESA) EO4EP - EO geoinformation services (ESA & World Bank)
– SAFEDAM - remote sensing levees monitoring service (NCBiR)
– E-Knot - awareness rising in terms of GNSS (H2020)

Customers and partners

– ESA
– European Commission
– World Bank
– NCBiR
– Airbus Defence and Space
– Space Research Centre, Polish Academy of Sciences
– Spirent Communications
– RUAG
– SODERN
– UWM Olsztyn
– Warsaw University of Technology
– AMW
– WSPOL
– IMGW
– State Fire Service
– Police.



Astronika Sp. z o.o.

was established in 2013. Astronika's founders hail mainly from the Space Mechatronics and Robotics Laboratory, where the engineers 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 the service of the full life cycle of the project, Astronika constantly extends the manufacturing, laboratory and test infrastructure, at the same time maintaining an extensive network of subsuppliers that ensure the highest standards of performance.

Products & services

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

Fields of activity

- Antennas,
- Application & Robotics Systems, Applied physical Science Technology,
- Automation & Robotics components and Technologies,
- Collaborative and Concurrent Engineering, Exploration tool technologies,
- Inflatable and deployable structures, Instrumentation in support of Physical Scien- ces,
- Materials Processes,
- Mechanism core technologies,
- Mechanism engineering,
- Non explosive release technologies, Supporting propulsion Technologies and Tools,
- Structural design and verification methods and tools,
- Coatings and tribological layers,
- Tribology technologies,
- Verification and AIT.

Selected projects

- "HDRM for the EUROSTAR 3000 Deployable Reflector Assembly" - project carried out in cooperation with AIRBUS Defence and Space,
"Lunar Drill Development. Phase A" - project carried out under Leonardo SPA leadership;,
„Hammering Mechanism for HP3 Penetrator" - project for the German Space Agency (DLR), developed for the NASA InSight Mars mission,
„JUICE RPWI LP-PWI and RWI" - project reali- zed for ESA, comprise analysis, manufactu- ring, integration and tests of two devices for JUICE mission - deployer for Langmuir probe and radio waves antennas,
- "BoomCoat" - main objective the 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, „Rad-Mag Instrument Implementation for RADCUBE IOD Mission" - project for Hungarian company
- C3S, comprises the provision
- of a tubular boom for science probe.

Clients and partners

- Airbus Defense & Space,
- European Space Agency (ESA),
- Jet Propulsion Laboratory NASA,
- Leonardo SPA,
- German Space Agency (DLR),
- OHB,
- Thales Alenia Space,
- Centre for Energy Research Hungary (MTA EK), Space Research Center Polish Academy of Science,
- Warsaw University of Technology,
- Swedish Institute of Space Physics,
- Tohoku University.

Bit by Bit Sp. z o.o.

BitByBit Sp. z o.o. is a software development company focused on R&D projects. The company was started in 2013 under name Recoded, in 2018 the company was formally transformed into a limited company under the name BitByBit. The company is managed by graduates of the prestigious Top500 science and management program at Stanford University in the USA. The company focuses on the development of the Internet and mobile applications for science, industry, and NGOs. It specializes in Python, Java, Javascript, and most of the related frameworks. We create our solutions based on the Design Thinking methodology.

Our research interests include space industry, machine learning, artificial intelligence, knowledge discovery, image, and sound recognition, metaheuristics optimization, multiple criteria decision analysis, investor wallets optimization, cryptocurrency markets, and participatory economy. Our core skill is software development, and we contribute to the space industry, within three areas: user interfaces, infrastructure management, and data processing.

Profile

Our offers software development services covering:

- Web applications - using technologies like: HTML, CSS, JS, ReactJS,
- Mobile applications - using ReactNative and Angular framework,
- Scientific software development - using: NumPy, SciPy and R language,
- Backend development - using Python and Django, Java, and OSGI/Play frameworks.

ESA cooperation

Our cooperation with ESA started in 2015 when we supported ITTI Sp.zo.o. with the project **The Technology Framework For The Development Of Modular, Portable, and Adaptive Human-Machine Interfaces in Ground Segment Software Product**: Since then the BitByBit company realized the following projects for ESA:

- **EGS-CC Web Interface (project for ESA)** - project for ESA whose purpose was to build a proof of concept of the web interface that interacts with existing EGS-CC kernel through dedicated OSGi bundle. The front-end application will communicate with the existing ESA system through the dedicated bundle - OSGi-JS bridge. The proposed proof of concept is focusing on visualization of reporting data.
- **WebUI (project for ESA)** is a set of ReactJS components dedicated to the Space Industry. Thanks to the library engineers from ESA can quickly prepare applications for scientists conducting observations. The library is compatible with the emerging Common Core standard and is applicable in all ground ESA systems. JS-Bridge is an OSGi library that allows interaction with space systems compliant with the Common Core standard through Internet technologies such as REST or Web Socket.
- **EGS-CC Web-based user interface** - the web user interface for EGS-CC. It is a production-ready web application that covers all functionality of the existing EGS-CC UI eclipse application. It will be a lightweight and flexible alternative to the Eclipse-based EGS-CC heavy client. To achieve this goal, the client will be implemented using web technologies, which are characterized by very low cost in terms of development time and required resources, as well as maintenance and support. Thanks to this solution, it will be possible to introduce the full automation of EGS-CC tests.

Selected other projects:

Geoplan is a geoportal supporting public participation in spatial planning. We've implemented two complementary methods of public participation in spatial planning: (1) analytic-deliberative process and (2) SoftGIS method, in which residents' local knowledge is elicited by means of map-based questionnaires. The project is funded by The National Center for Research and Development (PBS3/A9/39/2015).Technology: We use Python/Django for server site and React and React for front-end and React-Native for a mobile app.

Homini SOS is a social application that connects disabled people with volunteers who are willing to help. Thanks to the application disabled person can easily report the problem that volunteers will be able to quickly resolve. Technology: Python/Django for server site and React-Native for mobile application.

VTracker is a vessel monitoring solution based on the Automatic Identification System. It consists of two sides, on vessel client and server. Designed and build for Bibby Offshore Ltd. Technology: Django/Python for the server and Go Lang for the client application.

Space Engagers - web-based tool enterprise which enables communities to engage with local issues and spaces that matter to them through interactive mapping. Thanks to the platform it is possible to bring together the observations, knowledge and ideas of citizens into one map to help reveal the bigger picture and provide a platform for discussion and innovation. The project was built with Python, Django, Postgresql with PostGIS, ReactJS, HTML, CSS.

Ecostructure - a web-based platform with interactive maps and GIS analysis was built to raise awareness of eco-engineering solutions to the challenge of coastal adaptation to climate change by providing developers and regulators with accessible tools and resources, based on interdisciplinary research in the fields of ecology, engineering and socioeconomics. The project was built with Python, Django, Postgresql with PostGIS, ReactJS, HTML, CSS.

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 had various experience in conducting space industry projects. Currently the company is offering technological expertise services, as well as product definition of services utilising satellite data and providing information services related to the space sector. The company is working on internal projects utilising Global Navigation Satellite Systems, 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 work results are regularly presented and published, for example at International Astronautical Congresses (IAC).

Products and services

Consulting and information services, applications and hardware projects:

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

More information:

Areas of activity in the space sector:

Spacecraft Environment & Effects
System Design & Verification
Mission Operation and Ground Data systems
Space Debris
Ground Station System and Networks
Materials & Processes
Integrated Applications

Space industry projects (including R&D activities):

– HATCH (H2020, www.spacehatch.eu): a scalable, interactive and user-friendly platform-tool listing European space projects and related services.

– FLAMINGO (H2020): project on increasing positioning precision with Galileo Initial Services in city environments utilising many typical devices available on the market. The system demonstration will take place in Gdansk.

– GroundEye: management system for moving devices on airports (navigation + IoT).

– Designing a multifunctional harness for space and aviation electronics with special consideration to power electronics.

– TILQ (ESA): thermal analysis for cities demonstrator to determine life quality factors.

– INSUTRAX (ESA): integrated application (satellite data + IoT) as a new insurance service.

– Space3ac: accelerator program supporting entities with products utilising telecommunications and satellite data.

Laboratories and technical facilities:

The company maintains an 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 present: 3D printers, soldering stations, measure instruments, microscopes and oscilloscopes.

Clients and partners

ARP,
POLSA,
CBK PAN,
ESA,
academic entities,
Polish space sector and ICT companies,
PARP,
PSSE.

Centrum Astronomiczne
im. M. Kopernika Polskiej Akademii Nauk CAMK PAN

Centrum Astronomiczne im. Mikołaja Kopernika PAN (Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences - eng.) is a leading astronomical institute in Poland. It was established in 1978. The main subjects of research include: stellar astrophysics, binary systems, circumstellar matter, dense matter and neutron stars, black holes, accretion processes, structure and evolution of active galaxies, cosmology, extrasolar planets.

Areas of activity in the space sector:
- Space System Control
- Mission Operation and Ground Data systems
- Space Debris
- Ground Station System and Networks
- Life & Physical Sciences
- Optics

Research and development areas:
- H.E.S.S., CTA (observations of high energy photons (TeV) via detection of Cherenkov radiation)
- SALT (Southern African Large Optical Telescope about 10 m in diameter)
- LIGO-VIRGO (detection of gravitational waves)
- Araucaria (calibration of the local extragalactic distance scale)
- SOLARIS (search for extrasollar planetary systems)
- AstroGrid-PL (polish platform for numerical computations)
- Polish Bolid Network (observations of meteors and comets)
- Gaia-ESO (the great spectroscopic review of the Milky Way)

Space projects:
- INTEGRAL, Fermi (satellite observations of gamma rays)
- BRITE (the first Polish scientific satellite)
- ATHENA (satellite observations in X-rays)

The ground station for the control of the scientific satellites BRITE is located at the CAMK PAN.

Clients and partners:
- ESA (European Space Agency)
- NASA (USA)
- CNES (Toulouse, France)
- IRAP (Toulouse, France)
- MPE - Max Planck Institute for extraterrestrial Physics (Garching, Germany)
- Stanford University (California, USA)
- Harvard University (Cambridge, USA)
- Durham University (UK)
- Institut d'Astrophysique (Paris, France)
- Institute of Space and Astronautical Science (Japan)
- Ioffe Institute (St. Petersburg)

Centrum Badań Kosmicznych PAN

Centrum Badań Kosmicznych Polskiej Akademii Nauk (Space Research Centre of the Polish Academy of Sciences) 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 the 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 like: navigation, telecommunications and Earth observation.

CBK PAN has constructed over 70 instruments sent into space on board various satellites and interplanetary probes including Solar Orbiter, Chang'E-4, InSight, Herschel, Koronas-Foton, Rosetta, Mars Express and Cassini-Huygens. The first Polish scientific satellites – 'Lem' and 'Heweliusz' – were also developed at CBK PAN.

The prestige and unique character of CBK PAN can be seen in the 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

Space instruments – roentgen spectrometers, radio spectrometers, thermal sensors, optical Fourier and hyperspectral spectrometers,

Satellite subsystems – power supply systems, onboard computers, mechanical structures and thermal systems, orientation and satellite stabilization systems, communication systems, supporting ground systems,

Satellite navigation – precise positioning using GPS, EGNOS and GALILEO reference stations, precise time transfer system,

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, terrain classification software using optical and radar photography.

Services

Satellite platform integration,
Tests of subsystems,
Quality control and preparation of documentation.

Areas of activity in the space sector:

Automation,
Telepresence & Robotics,
Electromagnetic Technologies and Techniques,
Flight Dynamics & GNSS,
Materials & Processes,
Mechanisms & Tribology,
Mission Operation and Ground Data Systems,
On Board Data-Systems,
Optics,
Optoelectronics,
Quality,
Dependability and Safety,
RF Payload and Systems,
Space Debris,
Space System Control,
Space System Software,
Spacecraft Electrical Power,
Spacecraft Environment & Effects,
Structures & Pyrotechnics,
System Design & Verification.

Space projects

Main experimental research in the space environment,

wave experiments in plasma around the Earth,

remote (optical and microwave) sensing of planets and other space objects (PFS/MarsExpress, MERTIS/BeppiColombo),

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).

Participation in astrophysical research (INTEGRAL gamma ray observatory, HERSCHEL far infrared ray observatory, BRITE – two first Polish scientific satellites); involvement in the usage and development of global satellite navigation systems (GPS, EGNOS, Galileo), observations of satellites in Earth orbit.

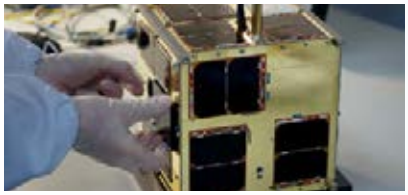
The Institute employs over 200 employees, including qualified scientific and engineering staff. Most of the work is conducted in Warsaw, Solar research is being done in the Wrocław department of the CBK PAN (Solar Physics Division), work on the Atomic Time Scale and satellite observations are carried out in the Borowiec Astrogeodynamic Observatory, and Dynamics Laboratory of Satellite Manipulators works in Zielona Góra.

Research and development areas

Solar physics (Wrocław division)
Studying planets and small Solar System bodies
Interplanetary space physics and astrophysics
Plasma physics
Planetary geodesy and geodynamics
Earth observation

Laboratories and technical facilities

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, 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, a mobile GNSS laboratory, the Regional Warning Center for Space Weather.



Cervi Robotics Sp. z o.o.

Cervi Robotics is the R&D company providing consulting, prototyping, and solutions implementation services focused on robotics, unmanned aerial vehicles, and the Internet of Things. The scope of work includes rapid prototyping and Research & Development outsourcing for clients. Cervi is listed in the TOP10 UAV companies worth following and TOP30 World Startups, according to InfoShare. Cervi is the laureate of numerous competitions, including the Imagine Cup and Dragon's Den. Vadym Melnyk, CEO Cervi Robotics, is the prizewinner of the prestigious Forbes „25 under 25" ranking.

The Company specializes in the following fields:

automation and robotics, UAVs, mechanics and mechanical engineering, algorithms for robot automation, machine learning, and the Internet of Things.

The Company's headquarter is located in Aviation Valley in Jasionka, where we have access to advanced machinery park. Cervi is using unmanned aerial vehicles not only for space sector development but also for other economic branches. The Company supports project implementation on every stage of the new product, from development study, prototyping to the mass production process.

Technology areas:

machine learning, AI, computer vision, big data, cloud computing, CNC, composites (kevlar, carbon), 3D printing, FDM, or SLA.
Company size: MSP

- Production of Unmanned Aerial Vehicles, spacecraft and similar machines
- Production of remote-controlled robots
- Building advanced drone solutions together with the European Space Agency
- Creating tailor-made solutions for demanding Industry 4.0
- Drone services

Projects:

Dronhub

the system of the autonomous drones docking station, excluding human involvement in servicing operations. The system is capable of maintaining any conservation issue and providing advanced data processing software.

Airvein

the system of drones responsible for cargo transportation dedicated to the U-Space - airspace in urban areas. The goal is to reduce human involvement in the transport process to a minimal level. Drones could also offer a safe, effective, and fast way to deliver blood products or medicines to hospitals by saving the time to spend on traffic jams. The drone can complete a flight in about three minutes, and in the same situation, drivers need 30 minutes in average daily traffic.

CloudFerro Sp. z o.o.

CloudFerro is a provider of cutting-edge cloud services. We provide and operate cloud computing platforms for specialized markets, such as the European space sector. Our broad experience and in-depth expertise include storing and processing big data sets, such as multipetabyte repositories of Earth Observation satellite data.

Products and services

- **IaaS** (Infrastructure as a Service) services in public, private or hybrid cloud model; computing, storage, cloud management, virtual networks, and XaaS virtual appliances,
- **EO Observation Data Repositories** for the Copernicus and other satellite data (over 20 PB of online data),
- **Various EO data access interfaces**: file-based (NFS), object-based (S3), OGC WMS/WMTS, supporting large data volumes,
- **PaaS** (Platform as a Service) services for EO data and **PGaaS** (Product Generation as a Service) allowing mass product processing,
- Commercial access to **EO VHR** data (spatial resolution even below 50cm).

Benefits for the customer

- **Full IaaS** (Infrastructure as a Service) under one roof: public cloud, private clouds, dedicated servers, hybrid solutions - fully configurable as needed; extended with **PaaS** addressed to the satellite community,
- **Open Source**: we use a mature and flexible cloud management system based on Openstack and Ceph technologies, which are industry standards, and therefore we ensure there is **no vendor lock-in**; open code enables environment auditing, which in turn increases project security,
- **Security**: all servers and systems are located in dedicated neutral data centres in the European Union, which have been designed in accordance with ISO 9001, ISO 27001 certified Tier III standard; high sums insured for operational activities and services,
- **Service mode**: use the services you need at your convenience, without having to configure or expand the infrastructure or undertake further investment; easy budgeting,
- **Reliable technical support**: available 24/7, provided at all levels by a highly capable and competent local team,
- **Compliance with EU laws and standards**,
- **Cost-efficiency**: we offer flexible, effective cost models, discounts and finance options.

Clients and partners

We are **one of the largest cloud service providers** for the European space sector. We have built, operate and provide cloud computing services for two out of five European **Copernicus DIAS** (Data and Information Access Services) platforms: CREODIAS and WEkEO. Our clients include:

- **European Space Agency (ESA)** - we provide public cloud computing services with the integrated satellite data repository,
- **European Centre for Medium-Range Weather Forecasts (ECMWF)** - we deliver hybrid cloud computing services, ensuring access to climate data, analyses, forecasts and indicators,
- **EUMETSAT and MERCATOR** - we provide hybrid cloud computing services with access to satellite data, specifically relating to ocean, land, atmosphere and climate monitoring,
- **German Space Agency (DLR)** - we support the CODE-DE platform that combines access to Earth Observation data with flexible processing.

We are a partner in H2020 projects. We work with nearly 30 scientific institutions and research centres throughout Europe, including the Warsaw University of Technology in the CENAGIS project. We are a member of the European Open Science Cloud.

Very high resolution (VHR) image of London

CREODIAS Finder - tool for searching for EO products

One of the CloudFerro data centers

Creotech Instruments S.A.

Creotech Instruments S.A. was established in 2012. In 2014, the state owned Industrial Development Agency became a strategic shareholder of the company. Creotech's flagship project is the HypeSat multi-mission microsatellite platform weighing between 10 and 60 kg, equipped with an on-board supercomputer, SDR radio, based on the SpaceVPX standard and compatible with CubeSat modules. The project is financed under the National Center for Research and Development grants. The first mission is scheduled for 2023.

The company owns special production facilities dedicated to space projects. It comprises of three clean rooms with a total area of 250 m2 and production equipment (including automatic electronics assembly lines) and testing equipment. The company has obtained ESA qualifications for the production of electronics for space applications (as the only one in Poland), and has introduced a quality system according to the following standards: ISO 9001: 2009, ISO 13485: 2012, IPC J-STD-001, IPC 610.

To date, Creotech has completed over 25 projects for the space sector, including a number of projects for ESA and for private Space 4.0. Creotech devices are on 10 space missions, including ESA missions: OPS-SAT, ASIM, EXO-MARS2016. Creotech is also participating in the following future missions: JUICE, PROBA-3, MET-OP.

Products and services for the space sector

- HyperSat satellite platform, support for the implementation of missions based on the platform.
- Microsatellites subsystems among others OBC, PSU, COMM.
- Vision systems in the CCD / CMOS optical band.
- EGSE subsystems.
- Contract manufacturing space electronics services.
- MLI production services and harness for satellites.
- Designing space systems and subsystems.

Downstrem activities

Creotech is the leader of the Copernicus Data and Information Access Service (CDIAS) project, the Copernicus data storage and sharing system. It also participates in a number of other projects related to the processing of satellite data. Creotech develops also UAV related products - drone data processing system, system for supervision of drone movement in public space, tools to add drone data to satellite EO data.

Other areas of activity

Creotech develops and manufactures scientific instruments, especially for data collection, processing and control, e.g. data synchronization systems with nanosecond accuracy, control systems for quantum processes (including quantum computers). The list of Creotech clients includes leading scientific centers, such as: CERN, GSI, NIKHEF, ITER, Oxford, Berkley, MIT. The company's products are exported to over 30 countries, inter alia to the USA, Brazil, Japan, India, Australia, Germany, France, Italy, Spain, UK.

Eversis Sp. z o.o.

Eversis Sp. z o.o. is a Polish technology company operating on the market since 2003. The company's mission is to support the business of its Customers by providing high-quality technological solutions. Since 2015, the company has been actively developing its activities in the space sector, offering dedicated information systems and applications which aim to process the satellite data. Within the framework of a strategic partnership with Airbus Defence & Space, the company executes a number of prestigious projects for the European Space Agency.

The team of Eversis includes 60 persons who have the competence to complete projects in the space sector (also using the ECSS methodology); among them are project managers, analysts, programmers, testers, Big Data specialists, and experts for teledetection.

Produkty i usługi

The company specializes in delivering the "tailored" solutions - created from the beginning, or those in which the ready-made software is adjusted to the customer needs.
We provide services which enable to perform the complete process of software development, such as:
– business and functional analysis of information systems,
– implementation and maintenance of information systems,
We have extensive experience in cooperation with the scientific and research institutions. Our technological expertise enables the implementation of the following projects:
– advanced internet portals and knowledge management systems (KMS),
– task management systems (including managing the instruments, such as satellites),
– systems for data processing based on Big Data technologies such as Apache or Haadop Spark.

More information:

Space sector projects:

Earth Observation portals (among others earth.esa.int, sentinel.esa.int) - maintenance, hosting, and development of the portals supporting the distribution of the satellite products and providing the technical information on the mission conducted by the European Space Agency. The main development objective of the company is to improve the portal to access the data in more intuitive, and thus more accessible way.

GEOSS Portal [Global Earth Observation System of Systems] referred to as data hub which provides the satellite products used by concerned groups of decision-makers, researchers, and analysts engaged in the constant observation of the Earth. The portal collects and provides the observational data from over a million resources, ie: satellite, remote sensing, and aerial data and photographs, and research materials from the whole world.

System Disaster Charter for International Charter for Space and Major Disasters supports the process of collection, delivery, and remote sensing data processing for the crisis management services. The system is activated in the event of natural disasters such as cyclones, tornadoes, earthquakes, volcanic eruptions, fires, technical failures, including pollution by oil and toxic radioactive substances. Due to the critical nature of the support, the application is available 24 hours a day 7 days a week.

Clients and partners

European Space Agency, Airbus Defence & Space, T-Mobile, T-Systems, Bank Pekao, Bank BPH, BNP Paribas, Avon, Inter Cars, Andra, Exatel, Netia, Kapsch, Sygnity, HSBC, IKEA, UPC, NBP Narodowy Bank Polski.

Exeon Sp. z o.o. Sp. K.

EXEON is an interdisciplinary consultancy firm. We provide research and development services. We design, engineer and bring to market innovative products, services and solutions.

Main areas of activity

Our main expertise focus on mechanical engineering and industrial design services. We offer
a complete set of skills and capabilities during the whole product/ system development process. Starting with the general idea or design problem, our team will help you on every stage of the project, from its inception until its implementation. We offer a broad spectrum of CAx services as well as FEM simulations, and rapid prototyping. Additionally we offer services related to vision systems and robotics.

The key to our successful performance is the team. We are a group of experienced professionals, academics and young, talented engineers and designers.

The company provides comprehensive R&D services for customers around the World in challenging applications ranging from medical devices, robotics, to transportation design and complex consumer products.

Space sector related services

Our experience in the domain of space exploration comes from several projects we have been involved in, being a part of international research teams working for MIT and NASA. Our expertise includes human space exploration, space suit design, ergonomics and human factors.

We target our offer to all size organizations which outsource or insource R&D services.

Services

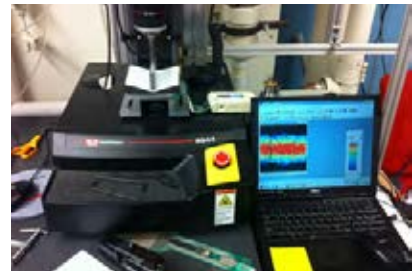
INDUSTRIAL DESIGN RELATED SERVICES

MANAGEMENT & QUALITY RELATED SERVICES

ENGINEERING RELATED SERVICES

CAx RELATED SERVICES

SOFTWARE AND VISION SYSTEMS RELATED SERVICES



Fundacja Partnerstwa Technologicznego Technology Partners

A scientific research organisation established in 2003 and awarded the status of Advanced Technology Centre. It specialises in research and innovation management and the performance of complex interdisciplinary research projects. Technology Partners' key competences relate to materials engineering (e.g. functional nanomaterial-based composites, ice-phobic coatings, modelling) and technology transfer to SMEs. Besides the space sector, Technology Partners primarily cooperates with the aviation and automotive sectors.

Technology Partners mission is to develop and support the Polish R&D sector's cooperation with the international scientific community and industry. Technology Partners carries out research primarily within international consortia within the European Framework Programmes for Research and Innovation: FP7, H2020 and since 2021 under Horizon Europe and on behalf of industrial partners.

An example of its activity within the space sector is the GO2SPACE-HUBS - Generating New Solutions to and from Space through Effective Local Start-up HUBs project. The objective of GO2SPACE-HUBs is to establish conditions for the creation and scaling up of European businesses offering technology and services in and from the space-sector. It foresees the creation of 3 new Space Hubs in Madrid, Tallinn and Coimbra, strengthening local entrepreneurship / business ecosystems and networks.

Technology Partners has been nominated for the Crystal Brussels Prize 2020 awarded for successes in participation in the Horizon 2020 Programme, which supported European research during 2014-2020. The distinction was awarded for innovation and contribution to the development of Polish science and economy by developing international cooperation.

Technology Partners is a long-term member of EARTO (European Association of Research and Technology Organisations), whose membership consists of the best European research organizations, and participates in the work of its Space Research working group.

Products and services

Our offer:

– Organisation and coordination of international research consortia, especially within the European Framework Programmes for Research and Innovation;
– Performance of research and development work at various TRLs, especially related to nanomaterials, composites, coatings and modelling.

Additional information

Technology Partners numerical data:

International projects: 19
- including H2020 and FP7: 12
Projects coordinated by TP: 3
Projects ordered by foreign industry: 11
Total value of projects: 200 mln EUR
Spin-offs created: 1
Number of project partners: 311
Partners' countries of origin: 48

Selected clients and partners

Aerospace Industries Association Of Canada; Airbus; Bombardier; Cluster Aerospace Technologies, Research and Applications (CASTRA); Commissariat à l'energie atomique et aux énergies alternatives (CEA); Consejo Superior de Investigaciones Científicas (CSIC); Fraunhofer; Instituto Nacional Técnica Aeroespacial (INTA); Iwczenko-Progress; Madrid Aerospace Cluster (MAC); National Aerospace University - Kharkiv Aviation Institute; Pratt & Whitney; SINTEF; Tecnalia; Ukrainian Research Institute Of Aviation Technology; VTT Technical Research Centre Of Finland

Geosystems Sp. z o.o.

GEOSYSTEMS Polska was founded in June 1995. Our work areas are related to spatial information in general, data acquisition technologies, processing, analysis and presentation. We conduct research and development and implementation work in such fields as remote sensing, photogrammetry and geographic information systems. We also engage in knowledge and technology promotion.

Together firm the Aqurat Ltd company, GEOSYSTEMS is successfully developing AutoMapa(R) since 2003 - the most popular in Poland automotive navigation system. In cooperation with Indigo Ltd. the company is also developing the web map portal Targeo(R). We are the producer of spatial data supporting these solutions and specialized products profiled for environmental monitoring usage. Since its founding the company is a software provider for image data analysis and processing. The traditional areas for the proposed applications, meaning remote sensing and photogrammetry, are currently complemented by institution offers, which include cataloging and websharing of all spatial data, as well as web-based collaboration using this information. GEOSYSTEMS Polska offers photogrammetry remote sensing software and GIS: Intergraph(R) ERDAS, Trimble(R) eCognition.

Products & Services

AutoMapa - an automotive GPS navigation system which includes 3D building renderings, complete road network and addresses linked to actual buildings. It was the first one in Poland to introduce AutoMapa Traffic, a traffic jam and sudden road obstruction avoiding system.

Targeo.pl - is the third most visited Polish map website by Polish users. It is based on the maps of GEOSYSTEMS Polska.

Spatial information databases - are the most complete and up-to-date collection of spatial information databases for the country. They were created in 2002 and since then were supplemented and updated on the basis of many sources, starting from satellite images to site surveys.

Software - the solutions offered by the company include tools well known to specialists in such areas as remote sensing, photogrammetry or WebGIS.

More info:

Areas of activity in the space sector:

Applications based on data from EO satellites
Applications based on data from navigation satellites

Main space projects:

Creating land coverage and terrain usage maps based on Earth observation satellite data: a database covering the full country done three times used in commercial applications.
Participation to the first PECS program edition. The project was: „Forest Monitoring Inputs for National Greenhouse Gas (GHG) Reporting"
The innovation lies in the usage of advanced methods of environmental studies based on satellite and flight images and their integration with in-situ obtained data.

Research and development areas:

Remote sensing applications and satellite photogrammetry
Data joining from many sources
Geographic information systems

Laboratories and technical facilities:

A few dozen of work stations and servers
GIS software, remote sensing, webGIS

Clients and partners:

Aqurat Ltd.
Indigo Ltd.
Intergraph(R)
Trimble(R)

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 develops in Poland the whole GMV portfolio of activities and performs their own projects with particular focus on three industries: Space, Intelligent Transportation Systems (ITS), defense and security. The global aim of GMV Innovating Solutions Sp. z o.o. activities is to provide IT solutions, integrated systems, specialized hi-tech products and services with close cooperation with clients and end-users.

Within few years GMV Poland become reliable partner, products and service provider for European Space Agency, Polish Space Agency, European prime contractors and satellite operators. GMV Poland possesses their own technical and service facilities and 80% of its employers are engineers (IT specialists, mechanics and telecommunication specialists).

Services

- Ground segment design and integration
- Ground Stations Monitoring Control Systems
- Ground Control Systems
- Flight Dynamics Systems
- GNSS receivers for space applications
- Software tools for SSA/SST applications
- Mission planning, Mission Analysis
- Engineering Support
- Guidance, Navigation and Control Systems (GNC)
- Attitude and Orbit Control System (AOCS)
- On-board software
- Independent Software Validation
- Autonomy and space robotics
- Services for different markets based on integrated satellites applications
- Payload Data Processing
- GNSS-based applications development for different markets

Products

hifly(R) - multimission multisatellite system for satellite monitoring and control, providing full integrated, homogenic support for big fleets of various satellites.

focuSuite - an unique software created especially for the need of flight dynamics of most satellite missions with the aim to develop non-standard solutions with high output.

flexplan - GMV's Commercial Off-The- Shelf solution for Generic Mission Planning and Scheduling. It manages the complete sequence of tasks related to the generation of a mission schedule, starting from the reception of mission events or instrument user requests, up to the generation of the complete conflict-free operational schedule. flexplan can easily support any complex mission, from Earth or Lunar observation to scientific interplanetary, and from single to multi- spacecraft.

magnet - a ground station and communication network monitoring and control system offering an advanced graphical interface, fully integrated with Hifly(R).

smart rings - a dedicated solution for orbit determination. Together with other GMV's products compose set of solutions for SST purposes.

Examples of space sector projects

- **OPS-SAT Phase B2/C/D/E1**
  Delivery of full on-board software for OPS-SAT satellite, deliver of ADCS and FDIR system. Satellite on-orbit from 2019.
- **GNSS SW receivers**
  GNSS software receivers for microsatellites and microlaunchers.
- **Mission Analysis**
  Mission analysis for BIOMASS and e.Deorbit mission
- **MetOp-SG**
  Development of Ground Processor Prototype (GPP) and instrument simulator (ISD) for scatterometer instrument.
- **BIBLOS**
  Development and maintenance of EO instruments software simulator applicable for different payloads, for example optical and SAR instruments.
- **SST software**
  Development of software for ESA/ESOC in SST domain. Delivery, deployment and maintenance of SST software for Polish National Operations Centre for SSA.

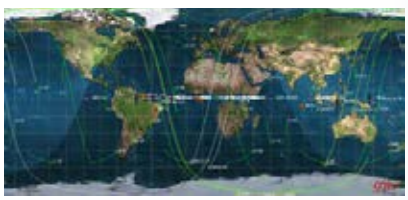
Additional information

- 1100 square meters full equipped office with IT infrastructure with dedicated software.
- Laboratory and service facilities
- CMMI Level 5 certificate
- UE and National Secret Clearance Certificate for Enterprise

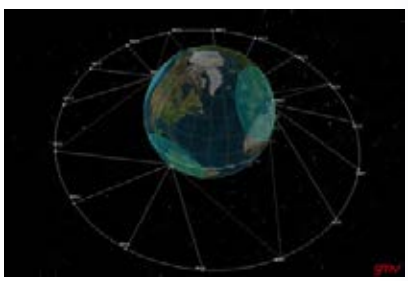
Clients and partners

- Europejska Agencja Kosmiczna
- Europejskie Centrum Operacji Satelitarnych
- Polska Agencja Kosmiczna
- Polska Agencja Żeglugi Powietrznej
- Europejski sector kosmiczny (Airbus Defence & Space, THALES ALENIA SPACE)
- Polskie przedsiębiorstwa i instytuty naukowe (Centrum Badań Kosmicznych PAN, ITTI Sp. z o.o.)
- Uczelnie wyższe (Wojskowa Akademia Techniczna, Politechnika Gdańska)

Oprogramowanie pokładowe dla misji ESA OPS-SAT



Oprogramowanie dla naziemnych stacji kontroli satelitów



Oprogramowanie SST
Oprogramowanie focuSuite

Grupa WB

WB Electronics S.A. is a private firm from Ożarów Mazowiecki with a fully Polish company capital. It is one of the more important companies from the Polish defense sector.
The company is one of the main suppliers for the Polish Armed Forces. Since more than 10 years it contributes to the improvement of defense abilities of the Polish army. This refers not only to the creation of new technologies but also to the upgrading of military equipment.

Next to giant companies WB Electronics S.A. is a small company, still its product offer can be compared. WB Electronics S.A. has since years been mastering new military electronic and informatics application areas.

The company's own new technology studies enable the creation of innovative products with unique utilities. WB Electronics S.A. offers mainly military electronics, software and services related to the integration of military vehicles. The most important customer of WB Electronics S.A. are the Polish Armed Forces. The company works also on the international arena.

The technologies offered by WB Electronics S.A. are based on year long experience coming from the company's solutions in the Polish military, its participation in international contracts, and long-term cooperation with the most demanding customers from the whole world.

Products and services

TOPAZ - a system supporting artillery command. It uses the most modern informatics and communication technologies. TOPAZ enables the coordination of actions on the squadron level and assures cooperation with higher levels of command accordingly to the interoperative principle.

FONET - a tool set with software, which forms an uniform exchange database for vehicles on the battlefield. One of its primary functions is to provide digital voice communication based on available communication means.

FlyEye - an unmanned aerial vehicle. It has an innovative take-off and landing system. It can be prepared for a mission in less than 10 minutes. It cooperates in artillery systems as means of fire recognition.

SKO-M - an artillery system supporting mortar commanding. It uses the most recent informatics and telecommunication technologies.

More info:

Areas of activity in the space sector:

System Analysis and Design
Automations and concepts
Automation & Robotics Systems
Automation & Robotics components and Technologies
Control electronics technologies
Mechanism engineering

Research and development areas:

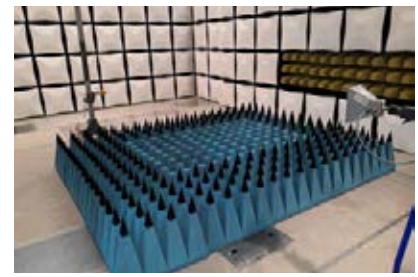
Radio communication systems - the development of modern communication solutions for usage in military systems.
Autonomic systems - the development of a series of unmanned aerial and land vehicles.
Fire direction - the development of artillery fire direction systems.

Laboratories and technical facilities:

WB Electronics S.A. has a construction office and production department. In the construction office there are employees with many engineering backgrounds: mechanics, electronics, software programming. The laboratory equipment include environmental chambers, specialist oscilloscopes and spectrum sensors. Owned software licenses enable full design processing.

Clients and partners:

War Studies Academy
Ministry of National Defense
Stalowa Wola Ironworks



Hertz Systems Ltd Sp. z o.o.

Hertz Systems Ltd sp. z o. o. has been operating with passion for technology for over 30 years, providing comprehensive services - from design to production, assembly, integration, testing and training. The company offers hardware and software solutions for the army, governmental and European institutions as well as private sector. For over a decade Hertz Systems has been active on the military market, providing the Polish Armed Forces with a satellite navigation receiver integrated with the SAASM cryptographic module.

The company is the only polish manufacturer of such kind of receivers. What's more, as one of the few companies in the country Hertz Systems has a cryptographic office and experience in the development and testing of equipment using cryptographic keys. The company has already supplied over 2,000 GPS receivers to the Polish Armed Forces. Further orders are being processed.

Since 2012, Hertz Systems has been implementing space projects related to GNSS systems for downstream applications as well as time and frequency synchronization and sensors for upstream applications. The company is also working on the development of PRS service, part of the European GALILEO system. Hertz Systems is one of the few Polish companies holding SAB accreditation for access to PRS technology. The company actively strives to produce PRS receivers in Poland.

Hertz Systems also specializes in systems ensuring safety of critical infrastructure (Hawk system for detection and neutralization of drones) and critical data (TEMPEST equipment).

The company is a high trust partner, which is confirmed by various certificates, licenses and implemented quality systems (ISO 9001, AQAP 2110 and 2210). The entity possesses the Industrial Security Certificate with the following clauses: ESA SECRET, EU SECRET, NATO SECRET.

Hertz Systems is member of the Consortium building Space Technologies Park, which will be located in the western part of Poland (nearby Zielona Góra, company headquarters). A number of specialized laboratories will be located there: Satellite electronics and FPGA, Robotic systems and artificial intelligence, Space Medicine, Clean Room, Processing and interpretation of satellite data and civilian satellite navigation systems, Materials engineering and strengths tests, Cryptography and counteracting cyber threats.

Products:

- Military, platform GPS receivers integrated with SAASM cryptographic module
- GNSS receivers
- Hawk system - detection and neutralization of drones
- TEMPEST equipment

Services:

- Development, production, testing and accreditation of GNSS receivers
- Testing and validation of satellite modules and GNSS receivers
- Design, installation, implementation, accreditation and maintenance of security systems
- Implementation and installation of communication systems
- Monitoring of vehicle fleets
- Additional Information

Areas of activity in the space sector:

- TD2 Space Systems Software
- TD6 RF Payload and Systems
- TD8 System Design & Verification
- TD10 Flight Dynamics and GNSS
- TD12 Ground Station System and Networks

Laboratory and technical facilities:

- Laboratories: Electromagnetic Compatibility, Acoustics and Electroacoustics
- Offices: Secret and Crypto
- Symulators: GNSS and HDL signals
- SimPRS software
- Digital oscilloscopes
- Spectrum analyzers
- CAD/CAE systems
- Matlab

Chosen research & Development projects:

- Development of Galileo PRS receivers for governmental authorities
- Network-centric system of movement monitoring and protection of airspace against UAV for prevention in public emergency situations, protection of critical infrastructure and public facilities
- Cryptographic GPS-SAASM/GALILEO-PRS satellite navigation receiver
- High Frequency radar for upstream applications
- GNSS signals interference monitoring

Clients:

European Space Agency
European GNSS Agency
European Commission
European Defense Agency
Ministry of Defense
Governmental institutions
NATO Agencies
Police
Emergency Services
Transport companies

Partners:

Science institutions (Space Research Centre, University of Zielona Góra, Warsaw University of Technology, Communications Institute, Wrocław University of Technology, Military University of Technology)
Thales Group
OHB
Rockwell Collins
Raytheon
Polish space sector companies

ICEYE Polska Sp. z o.o.

ICEYE

ICEYE is a world leader in the use of SAR (synthetic aperture radar) technology in microsatellites. The company supports better decision making by providing access to up-to-date and reliable satellite images for any place on Earth, regardless of the time of day or weather conditions.

ICEYE Poland is an important pillar of the company's operations. The team of over 40 employees makes up the Space Engineering Laboratories, Satellite Operations Centre and Customer Support Centre. Thanks to the location of key activities of the company in Poland, ICEYE significantly contributes to the development of the Polish Space Sector staff, enabling Polish engineers to develop unique competences. Polish engineers play an important role in the production process of key ICEYE satellite systems. The current infrastructure and competences of the Polish branch of ICEYE make it possible to conduct the satellite manufacturing process in Poland.

The Satellite Operations Centre is located in the company's Warsaw headquarters. It is here that the ICEYE constellation is supervised 24 hours a day, seven days a week. The Warsaw team is responsible for issuing commands to the satellites to make new acquisitions and transfer the acquired images to Earth.

The Customer Support Centre is responsible for ensuring the entire process of delivering satellite images to customers. The Warsaw team remains in direct contact with the customer from the moment of receiving a request for a given acquisition, through the stage of an order confirmation, ordering its execution to the employees of the Satellite Operations Centre, to the control of the quality of the acquired data and its final delivery to the customer.

ICEYE Poland works on programming FPGA (Field-Programmable Gate Array) systems responsible for receiving and processing signals from SAR radar, as well as designing communication systems for its satellites. In addition, Polish engineers are involved in the integration and testing of selected components of radio communication systems. An important part of ICEYE's activity in Poland is the work of the AIT team of engineers, involving the assembly, integration and testing of key satellite platform components responsible for the operation and monitoring of many significant satellite systems.

A number of research and development works on systems used in ICEYE satellites are conducted in Poland. The work is in progress on the key component of the satellite platform - the Attitude Determination and Control System (ADCS) for observation microsatellites. It will be fully developed and manufactured in Poland. Then the finished prototype will be integrated with the satellite and tested in space. Another undertaking is to develop and build an integrated module for SAR radar management dedicated to observation microsatellites. These modules, fundamental for the mission, will be tested according to the highest standards and finally verified in real-life conditions on orbit. The project will enable the more efficient acquisition, processing and sending of larger amounts of radar data to ground-based receiving stations.

Projects:

ICEYE is the first company to develop a synthetic aperture radar (SAR) satellite with a launch weight of less than 100 kg.
Development and verification in real conditions of the integrated SAR radar management module dedicated to observation microsatellites.
Development and testing of the Attitude Determination and Control System (ADCS) for observation microsatellites under real conditions.
Innovative radar service to monitor landslides in near real-time

InPhoTech Sp. z o.o.

InPhoTech is a high profile company of advanced technologies which creates modern optical fiber solutions and implements them in industry. The company's core business is the transfer of innovative solutions to industry and the development and production of intellectual property in the field of photonics – referred to as the leading technology of the 21st century.

InPhoTech's unique Polish special optical fiber technology provides a flexible approach to solving the challenges faced by industry. This provides industry with an increased level of **safety and efficiency**, whilst enabling a **rapid increase in productivity and competitiveness**. The sectors to which InPhoTech solutions are addressed include: **telecommunications, medicine, mining, oil and gas, defense, railway and many others**. The company is open to challenges in new fields, making the impossible possible - thanks to photonics.

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Additional info

InPhoTech develops and implements following technologies:

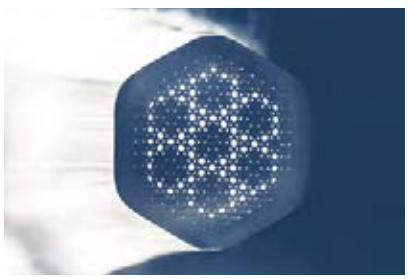
- fiber optic distributed sensors;
- special optical fibers (f.e.: microstructured, multi-core, birefringent, non-linear, active, with low bending losses, with many coats, with high and low numerical aperture);
- metal-coated optical fibers (including gold, copper, silver).

Products and services

- Passive and active optical fibers hardened against cosmic radiation, for onboard systems communication
- Active multicore optical fibers for space-borne fiber amplifiers
- Passive optical fiber sensing elements (ex. bend sensors)
- Specialty optical fibers for harsh environments applications including high temperature, high acidity / alcaline
- Fiber optics measurement systems (temperature, strain, pressure, vibration), including systems with structure-embedded sensors
- Fiber-composite integration technology
- Fiber-metal bonding technology

Customers and partners

- Airbus Defence & Space
- ESA
- Goosh & Housego
- Śląskie Centrum Naukowo-Technologiczne Przemysłu Lotniczego
- Fibrain
- Xpanse
- Uniwersytet Marii Curie-Skłodowskiej



Instytut Łączności
Państwowy Instytut Badawczy

Instytut Łączności - Państwowy Instytut Badawczy (The National Institute of Telecommunications - eng.) is a scientific research unit supervised by the Minister of Digital Affairs with the status of the State Research Institute. Its activity includes research in the field of telecommunications and information technology. The Institute provides scientific, research and technical support to state institutions and implements numerous research projects financed from domestic and international resources.

The Institute has 8 research departments and 4 well-equipped specialized laboratories accredited by the Polish Centre for Accreditation. In March 2020 NIT opened first Polish Information Technology Security Evaluation Facility assessing compliance according to Common Criteria.

National Institute of Telecommunications conducts works in the field of, among others, planning and designing of telecommunications networks, radio communication systems, broadband access networks and optical networks, network and service security, network management, designing of computer methods for decision support and methods of knowledge management, electromagnetic compatibility of devices, networks and systems, software for telecommunications and information technology, optoelectronics, satellite techniques, development of special communication systems.

In addition to research activities, the Institute offers technical consultancy services, calibration of equipment and tests in accredited laboratories, conducts professional training, develops and implements specialized equipment, organizes seminars and conferences and publishes scientific journals.

The Institute is involved in projects of key importance to Polish state. It actively participates in the work on the launch of 5G technology in Poland and conducts studies on electromagnetic fields, especially in the vicinity of cellular telephony base stations. It also operates in the area of cybersecurity by developing methods and techniques for assessing the security of devices and their certification.

Areas of activity in the space sector:

- Power system architecture
- Telecommunication (sub-)systems
- Antennas
- Automations and concepts
- Photonics

Main space projects:

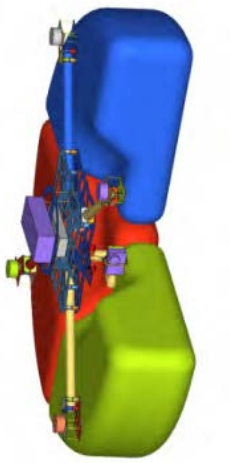
- A concept design for an universal GALILEO system receiver for maritime navigation, done in form of software defined radio
- The Polish Atomic Time Scale TA(PL) database development
- Maintenance of time transfer system (together with Polish Central Office of Measures) using fibre-optic cable connection and two-way satellite system (TWSTFT) with SDR receiver for the purpose of connecting the Official Polish Time UTC (PL) to the international time scales
- 3PfD and GIMME PRS projects - quality measurements of PRS service (Public Regulated Service) in Galileo system
- RIDETA project - testing of the new algorithms detecting different types of interferences in GNSS signals using especially inertial techniques (INS)
- VDE Future/Jericho VDE project - identification and specification of two new services for maritime sector using satellite and ground elements of VDES system
- SAT-AIS-PL Phase A project - providing at the level of the feasibility study a mission of AIS microsatellite
- EfficienSea 2.0 project - development of VDES (VHF Data Exchange System), including its satellite component

Instytut Podstawowych Problemów Techniki PAN

Instytut Podstawowych Problemów Techniki PAN (The Institute of Fundamental Technological Research of the Polish Academy of Sciences - IPPT PAN - eng.) was established in 1954 and the main task of the Institute is to conduct high

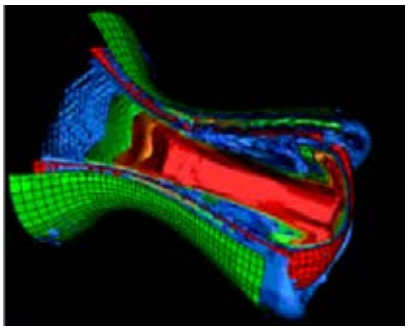
The most important fields of the Institute's expertise include theoretical and applied mechanics, theory of coupled mechanical and physical fields, theoretical and experimental mechanics of materials and structures, computational methods in mechanics, acoustoelectronics, and ultrasonic medical diagnostics. Extensive research is also conducted in several branches of fundamental science and technology, such as: physics and thermodynamics of continua; plasma physics; stochastic dynamics; fluid mechanics; laser beam interaction with metal surfaces, nanophotonics, applied mathematics, applied informatics, and bio-informatics.

The Institute has an extensive experience in international co-operation particularly in the area of international Research and Technology Development projects (RTD).
Great importance is attributed to various forms of co-operation with industry. Together with the results of scientific research, the Institute has developed a wide range of modern technologies.
Today IPPT PAN employs over 140 scientists and researchers, including 48 professors and provides first-rate PhD education in contemporary technology, mechanics, acoustics, computing, and its advances related to biomedical applications, enhanced by internationalization, links with industry, and the encouragement of a discovery spirit.



Fields of education

1. advanced materials and nanotechnology – X
2. aerospace engineering – X
3. applied automation – X
4. astronomy – NO
5. automatic control and robotic – X
6. aviation and cosmonautic – X
7. electronics and telecommunication – NO
8. industrial computer science – NO
9. materials engineering – X
10. mechanical engineering – X
11. mechatronics – X
12. navigation – NO
13. oceanography and ocean engineering – NO
14. system engineering – X
15. technical physics – X
16. tele and applied informatics – NO



ITTI Sp. z o.o.

ITTI is a software development company which provides IT solutions and technologies to companies and institutions in Poland and abroad. The main goal of the company is to develop innovative applications, tailored products and customised software solutions. For a number of years ITTI has also been involved in R&D projects (co)financed by national and international. The company headquarters are located in Poznań.

Product sand services

In space sector ITTI focuses on developement of software solutions in the following areas:
Support to AIT (Assembly Integration and Testing) activities during mission preparation,
On-board communication (e.g. SpaceWire, SpaceFibre, CAN),
SSA (Space Situational Awareness).

Additional information

Selected ITTI projects for ESA:
Software supporting the AIT activities:
– ATENA/ATENA+ - Adjusting open Test Exchange staNdard to the spAce domain,

– EGS-CC Build System Migration from Miven to Gradle,

– WebTMS - web-based version of Test Management System,

– INSPECTOR - INtegrated SPacE Components Test platfORm.

On-board communication:
– SpaceDet - Evolutions of SpaceWire Protocols for Deterministic Data Delivery,

– SPACEMAN - SpaceWire and SpaceFibre Network Management,

– Ethernet4NGSpace - Ethernet for Next Generation Spacecrafts.

Space Situational Awareness:
– P2-NEO-VI - NEO User Support Tools,

– P3-COM-VI.1 - NEO Data Centre and Applications Maintenance,

– E2EPOC - End-To-End Procedure for satellite Orbit Catalog from optical observation,

– SpaceStones - Space surveillance and tracking in observational network with event based sensors,

– NEODECS - NEO Data Exchange and Collaboration Service,

– NOAS - NEO&SST Observation Assistant Service,

– SANORDA - Service for Archival NEO Orbital and Rotational Data Analysis,

– SSA PL - Feasibility study to Setup a Polish Component to SSA.

Selected ITTI solutions:
Tools supporting NEO observations

ITTI (together with the Astronomic Observatory of the Adam Mickiewicz University) has developed a set of tools supporting astronomers in NEO (Near Earth Objects) observations, e.g. observation planning tool, 3D orbit visualiser, sky chart displaying tool, calculator tool. This set of tools was developed as a web service which will be available via ESA website.

ATENA - tool for designing and execution of fuctional tests

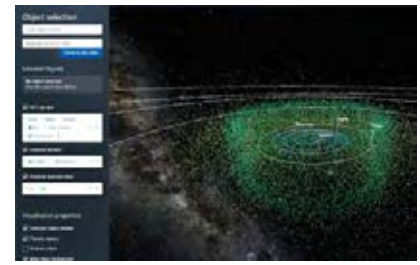
ATENA (Adjusting open Test Exchange staNdard to the spAce domain) is a tool for designing and execution of functional tests of satellite systems (as well as other complex systems). ATENA is based on OTX (Open Test sequence eXchange format) standard which is commonly used in an automotive industry. ATENA toolkit consists of OTX Editor and OTX Engine. Editor allows to build procedures in the form of graphics, tree or text (i.e. XML), while Engine is responsible for execution of procedures which are sent from Editor or introduced by a user from a system console. The system is capable of testing also MCS (ang. Mission Control Systems), which are based on EGS-CC (ang. Europen Ground Segment - Common Core).

SPACEMAN - SpaceWire and SpaceFibre network management tool

SPACEMAN is a software application for managing SpaceWire (SpW) and SpaceFibre (SpF) networks which are commonly used for on-board communication. The functionality of SPACEMAN includes: (i) networks comparison, (iv) Live visualization of SpW/SpF network changes, (v) Network model editing, (vi) XML representation of SpW/SpF networks, (vii) Packet-level testing (NDCP, RMAP, SpaceFibre and SpaceWire).

Customers and partners

ITTI runs projects in numerous international programmes managed by such institutions as: European Space Agency (ESA), European Commission (e.g. H2020 program), European Defence Agency (EDA), as well as European Network and Information Security Agency (ENISA).
Among ITTI partners one can find e.g. companies: Airbus, ATOS, AVL, Deimos, e-Geos, GMV-PL, Leonardo, Rheinmetall, Telespazio, Teletel, Thales Alenia Space, Vitrociset Belgium, PGZ SA, universities and research institutes.



Jakusz Space Tech Sp. z o.o.

Company was settled in 2015 for dealing space applications with specialization in propellant, rocket technologies, research and development projects. It is the derivative of Jakusz Sp. z o.o. (protection against explosion, munitions disposal, chamber for safe transportation of explosives, EMC protection), existing since 1985, and both belong to SME sector.

Main activities of Jakusz SpaceTech are:

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

Company provides also training services from handling Hydrogen Peroxide. Such training was performed for ESA. Jakusz SpaceTech is also investigating with partners technologies such as:

- rocket engines
- propellants
- fuel cells
- chemical engineering (oxygen extraction from lunar regolith
- neutralisation of process gases
- underwater drones

On company premises there is production and research facilities and design team. In the facility there is chemical laboratory in clean room.

Up to this day company staff participated in following projects in which company was **Prime contractor:**

- "Horizon 2020" Programme - SME Instrument Sub-contractors: 2 entities
Goal: Design of mobile container based platform for manufacturing Hydrogen Peroxide

- ESA: "High Concentration Hydrogen Peroxide Safety Validation Testing" Sub-contractors: 4 entities Goal: Production technology validation accordingly to MIL-16005PRF. Homologation of packings for transportation.

- **ESA: "Hydrogen Peroxide Storability/ Compatibility Verification" Sub-contractors: 11 entities** Goal: Physico-chem tests of Hydrogen Peroxide. Research showing with which materials (polymers, and metals) HTP is compatible and with which is not.

- ESA: "Optimization of passivation parameters for different aluminium alloys" Sub-contractors: 3 entities Goal: Creation of procedure for making protective layer on alliminium alloys which will protect then against corrosive substances

Jakusz SpaceTech is open to join in innovative projects in any role (prime, sub-contractor, consultant, supplier). **We are interested in development of new products and services** with other partners and commercialize them into market.

Kapitech Sp. z o.o.

Kapitech is a Polish, Warsaw based, consultancy office, founded in 2014, specialized in Space Innovations Management. Operates a strong European network built from twenty years of activities of its founders in the Space sector. The main goal is to increase level of competitiveness of the local entities with the support of territorial development through implementation of innovative technological projects in Space sector.

From 2016 is one of two official **Copernicus Relays partners in Poland** responsible for coordinating and promoting activities around European Union's Earth Observation Programme and its benefits and opportunities for local residents and business, as well as widening the community of Copernicus users, developing new applications and maximizing the benefits from Copernicus data and information.

Kapitech regularly participating in the European Commission and ESA projects, increases the level of cooperation and technology transfer between business and research units.

Since December 2019, Kapitech is involved in the implementation of the SnapEarth project financed under the H2020 programme. The ambition of the SnapEarth project is to foster the Market growth of COPERNICUS by instigating the development of new EO applications and to develop general public awareness to EO data. SnapEarth is to initiate the creation of a virtuous circle of innovation by providing to EO data users an innovative platform with leading edge EO segmented datasets, Neural Networks models and Cloud computing ecosystem. This will allow users even without knowledge of EO to perform complex semantic searches. Five innovative services will be developed by project partners based on the needs expressed by their customers together with an innovative platform and leading sets of Earth Observation data.

Kapitech is the leader of the PolAir project implemented as part of Climate-KIC financing. PolAir is a fully professional system combining information obtained from high-quality ground-based air quality measuring devices with meteorological and satellite data.
In 2016 and 2018, we organized space application hackathon #ActInSpace Warsaw. As well as in 2018 and 2020, Kapitech organized Copernicus Hackathon, enabling acceleration at Copernicus for a winning startup.

Kapitech is operating the Co-creating innovative place where the open innovation of the broad community meets the transfer of Space Technology Benefits on Earth. Kapitech's SpaceHUB is located in the innovative design and mind-blowing space called Brain Embassy. In the Warsaw local SpaceHUB, the community can participate in the workshops, contests, get business advice, use local pith rooms for their business development, by recording the pitches to investors and cooperate and communicate with the community on co-creation of new services.

Non-stop Kapitech provides technical support on data usage and access multimedia for interactive data visualization.

Services:

- Strategic consultancy in space,
- Support in bid management,
- Strengthen the market shares,
- Improve client operational performance.

Key projects:

- SnapEarth - Kapitech is the leader of task packages related to business aspects, and also implements one of the pilot applications under the name EarthClimate.

- PolAir - Kapitech is a project coordinator, under which fully professional system combining information obtained from high-quality ground-based air quality measuring devices with meteorological and satellite data.

- SpaceHub - Kapitech is operating the Co-creating innovative place where the open innovation of the broad community meets the transfer of Space Technology Benefits on Earth. SpaceHub provides services similar to space technology incubators, where start-ups can have a physical space and get support in development of idea and business in space.

- EO ClimLab - Kapitech as an Innovation Leader is responsible for international animation of the whole project, as well as for organization of hackathons under the name EOvation.

- Cooperation with the Marshall Office - Preparation of the Space Sector Assessment for Mazovia Region and organization of the first meeting of Mazovia Working Group for Space Sector.

- GALENA - Kapitech was responsible for conducting market study regarding implementation of new services in the field of satellite navigation and preparation of the event presenting developed solution.

Komes Sp. z o.o.

The aim of the company is to undertake and solve unusual engineering projects. Main activity of the company focus on Computer Aided Engineering (CAE) simulations at the expert level. The functionality and safety of customer's solutions are verified. Measurements, tests and diagnosis of prototypes as well as already in use structures are carried out.

The company prepare expertises, opinions and recommendations regarding issues in the field of structural theory, dynamics, mechanics of interaction of vehicles and equipment, unconventional solutions. Laboratory and technical facilities are constantly being developed. The company own the Mobile Laboratory of Mechanical Measurements.

The offer includes:

Numerical calculations to make projects meet the international standards

Fea stress analysis

- Static strength analysis,
- Vibration analysis,
- Structural dynamic,
- Impact and crash analysis,
- Thermal analysis,
- Advanced non-linear analysis,
- FE fatigue analysis,
- Optimization.

CFD consultancy

- Aerodynamics analysis,
- Hydrodynamics analysis,
- Industrial fluid dynamics,
- Heat transfer,
- Fluid structure interaction.

Products and design

- Designing mechanisms and structures,
- Designing structures supporting the integration and testing of satellites,
- Designing adapters, lifting, turning and supporting devices,
- Manufacture and production of structures and mechanisms,
- Testing, consulting in the field of physical and virtual tests.

Areas of marketing activity

- Systems of load-bearing structures and supporting ground observation systems,
- Structure mechanics of ground observation systems,
- Mechanics of the carrying structures of satellites and nano-satellites.

Tests and measurements carried out for prototypes and already in use designs

Special tests:

- Strain gauge measurements,
- Vibration and acceleration measurements Residual stress measurements by the hole drilling method,
- Gear stress tests,
- Large deformations studies,
- Testing in hazardous environmental conditions in explosive zone (EX),
- Hot deformation studies of parts at up to 950 ° C,
- Monitoring progressive cracking,
- Wireless measurements on rotating parts.

EXPERTISES AND COUNSELLING - comprehensive technical advice at each stage.

Technical expertises

- Technical condition evaluation,
- Assessment of technological and design advancement,
- Wear and tear assessment of machinery and equipment,
- Elaboration of measures for reconstruction or modernization of machinery and technological equipment,
- Corrosion diagnosis,
- Quality tests of welded joints.

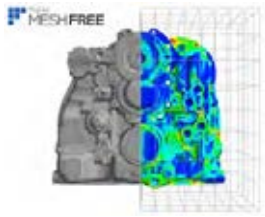
Sale of software

MIDAS NFX - the FEA engineering software with pre- and post-processor providing advanced and efficient structural simulations, flow simulations and optimization.

MIDAS MeshFree - a design and analysis cutting-edge technology developed. MeshFree performs finite element analysis on the original CAD model without need for meshing or defeaturing.

CAE Limit - a tool for providing advanced and efficient fatigue structural simulations.

AFT - software developed for dynamic the dynamic calculations of liquids and gases flow in pipelines software. Allows for fast, intelligent selection of sizes and types of pipelines, and the whole installation pipeline systems.
SDC Verifier - is a powerful FEM software with an advanced calculation core that verifies structures according to different design standards. The goal is to automate all possible routine work and speed up a verification of the engineering projects significantly.



We use our maximum knowledge and skills to meet the expectations of any Client. We work with many companies both Polish and foreign. Projects that we carry out are based on trust and longterm strategic cooperation. We know that the plans and concepts entrusted to us are extremely valuable.

Due to the existing agreements (NDA) the list of our customers is confidential. For that reason references are available for inspection only upon request. We have been realized about 750 projects. We use world-class measuring equipment from HBM, BARTEC SYSCOM, Vishay, LMS Siemens, Flir, PCB and IBIS-FS (microwave interferometry based system for remote static and dynamic monitoring). The Management System operating at KOMES meets the requirements of ISO 9001:2015.

KP Labs Sp. z o.o.

KP Labs is an innovative New Space company based in Gliwice. KP Labs delivers AI computers and software to complete demanding space missions.
Our mission is to accelerate space exploration through the advancement of autonomous spacecraft operation and robotic technology. We believe that space missions can be simple and self-managed. Applying autonomy into the Space Sector is an inevitable step towards reducing operational costs and the risk of mission failure. Our goal is to make this step possible.

We implement projects co-financed by the National Center for Research and Development and cooperate with the European Space Agency.

We focus on:

Imaging
- Hyperspectral imaging
- Advanced vision-based systems

Software
- Flight software & mission automation
- Testing and simulation (EGSE)

Computing
- High-performance computing
- On-board computers

AI
- Computer vision
- Machine learning

The key value of the company is the highly qualified staff of great potential and experience in R&D projects.

Our own **R&D facility** (to be completed in 2021) will consist of:
- Mission planning and control lab
- Communication systems lab
- Machine learning lab
- Electronics assembly and test lab
- EMC lab
- Mechanical design lab

Main domain of activity

The Intuition-1 mission, planned for 2022, aims to observe the Earth using a 6U satellite equipped with a hyperspectral camera and a Leopard computer to process data in orbit using Deep Neural Networks.

Our key solutions:

- **Leopard** - is a CubeSat standard-compliant Data Processing Unit which enables mission designers to apply AI solutions in space. It was designed to support the capturing, managing and processing of data in orbit. Leopard redefines the current approach to remote sensing. Instead of sending huge unprocessed sets of data to ground stations, Leopard uses Deep Neural Networks to process data on-board and therefore only sends the most important and valuable insights to the ground. By reducing the time and cost of data transfer and processing, it enables you to focus on a rapid response to any detected phenomena.

- **Oryx** - is an On-Board Computer Software development kit and toolset. Thanks to the modular architecture, it supports the rapid development of the mission software by using a library of components. It allows to execute software updates during the mission in the form of small scripts rather than replacing the entire software.

- **Antelope** - is an On-Board Computer equipped with an additional FPGA module for subsystem state analysis. It does not only support the operation of the satellite subsystems, but also allows for automatic self-diagnostics based on artificial intelligence. The machine learning- based algorithms constantly analyse the satellite's state and perform long-term detection and early warning of potential subsystem malfunctions. This in turn allows for predictive maintenance and the extension of mission's lifetime.

- **Artificial Intelligence** - we focus on solving real-life problems using AI-powered approaches, using both conventional machine learning (ML) and deep learning, handling the entire processing pipeline. We design the solutions and lead/participate in the ideation of AI projects while working in a variety of subfields of AI and image analysis: multi-/hyperspectral image analysis (high-dimensional data analysis), super-resolution reconstruction and timeseries analysis. We combine basic and applied research and disseminate our results.

Our partners:

In-Space Services - Earth Observation for Agriculture (Luxembourg),
Future Processing - Application Development (Poland),
FP Instruments - Electronics Design and Production (Poland)

Microamp Solutions Sp. z o.o.

Microamp Solutions is a deep technology start-up, based in Lublin, working on innovative RF active components and RF Front-Ends for modern 5G networks and wireless communication systems. The company was founded in 2019 as a response to the ongoing 5G revolution and the growing need for modern radio frequency services and products.

This is the only company from Central and Eastern Europe dealing with the development of modern RF hardware for commercial applications in 5G cellular networks. Microamp team is in an ever-evolving network, of technical and business specialists from top reputable organizations and institutions. The core team consists of graduates from Warsaw University of Technology who have been working for several years in RF industry in Poland, Singapore and USA.

Main projects

Currently, the company is working on two projects, both attributing to the field of RF innovations. The first project is related to the development of microwave power amplifiers technology for 5G New Radios and the second deals with complete RF Front-Ends and transceivers for 5G small cells and advanced antenna systems (AASs) operating in the sub-6 GHz bands (especially 3.4-3.8 GHz) as well as in X and mmWave bands. Microamp Solutions raised funding from VC and Polish Agency for Enterprise Development (PARP). In the nearby future the company is going to develop complete 5G RF solutions including Remote Radio Heads, small cells and AASs operating in sub-6GHz and mmWave bands.

Products and services

Power amplifiers

The startup specializes in RF Power Amplifiers and offers a broad range of such devices using the latest technology based on GaN, GaAs and LDMOS transistors. Microamp PAs are designed to operate in various frequency bands and power outputs.

RF Front-ends

Microamp team designs highly customizable RF Front-ends as a turnkey solution so that the clients can get products optimized for their extraordinary purposes.

mmWave Transceivers

Microamp Solutions develops and deploys multistage transceivers operating in X and mmWave bands for wide range of wireless systems.

RF Design

The company provides its partners with RF design to show them quick, smooth and cost-efficient path to full deployment of their products. Microamp Solutions specializes in designing, developing and manufacturing professional RF products for the international wireless communication and space industry.

All Microamp products are optimized in terms of minimum phase distortions, high efficiency, low size and cost what makes them applicable to 5G mMIMO systems with beamforming. Thanks to new design strategy, Microamp RF products meet requirements for high performance wireless communication systems and are suitable for various space industry applications.

Our clients

Microamp Solutions is of great interest to companies form telecommunication sector, in particular those dealing with development and deployment of 5G network infrastructure. The start-up is identifying potential customers among suppliers of the leading mobile operators in the telecom market as well as companies from space industry.

The future

Microamp Solutions creates technology that has the capacity to change our world and significantly impact large groups of people. The company goal is to be a market leader in RF solutions and provide the industry's broadest portfolio of modern wireless technologies opening new possibilities for business and fledgling technologies.

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 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 technologies reducing cost and improving reliability of the software for critical embedded systems used by space industry. With the strong support of SPACEBEL's 30 years of experience in the space industry and N7 Mobile's 10 years of the the mobile and backend systems software development, the company provides high quality software development services in the following domains.

- Application software for on-board systems (Leon3, ARM)
- Boot software and Board Support Packages for Leon3 and ARM CPUs
- MBSE technologies
- Test scripting engines
- Database software
- Ground segment software
- EGSE & SVF software
- ISVV

Major company projects and experience

PROBA3 ASPIICS payload software

N7 Space is the supplier of the on-board software for the Coronagraph Control Box, the scientific payload computer developed by Space Research Centre PAS in Poland, for the purpose of integration with ESA's PROBA3 mission. The company is responsible for the following project activities:

- Elaboration of the software requirements specification and technical design,
- Implementation of the boot software and the RTEMS-based application software running on a LEON3 processor/GR712RC,
- Software verification and validation activities,
- Delivery of an automated software testing framework for the software validation campaign.

Atmel ARM BSP with CANopen library

In the scope of the Polish Industry Incentive Scheme N7 Space developed reusable software components for future radiation-hardened ARM SAMV71 (Cortex-M7) microcontrollers. Objectives of the project are to deliver the following software components.

- Bootloader conforming to the SAVOIR requirements,
- Board Support Package for selected I/O modules,
- CANopen software protocol library.

Project was executed in partnership with Atmel (Microchip) responsible for providing end-user testing activities.

ASN.1/ACN modelling IDE

In the scope of the Polish Industry Incentive Scheme, N7 Space has developed dedicated ASN.1/ACN modelling IDE. This product provides modern development environment for the ASN.1/ACN languages used in data modelling for communication protocol design activities. Key features of the product are:

- code auto-completion,
- code highlighting,
- easy navigation between ASN.1 and ACN code blocks,
- PUS-C ASN.1/ACN data model library,
- Automatic tests generation.

Deployment of the PUS-C Standard in Projects supported by an Automatic Generation Toolset (©ESA)

N7 Space has had a unique opportunity to be a part of the 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.

Photo: ESA

Photo: ESA

Nobo Solutions S.A.

Our mission is to deliver world class engineering and R&D services with yet reasonable costs. We employ passionate engineers with experience gained in R&D and engineering departments of leading Polish and international companies. They are authors or co-authors of patented design solutions. They participate in international research projects in cooperation with consortia of European universities and research institutes. Numerical simulations are indispensable in nowadays design process.

Thanks to Computer Aided Engineering (CAE) today new designs are optimized, cost effective and better suited to customer needs. At the same time costs of experimental investigations can be reduced. Simulations support identification and elimination of the weakest points of the structures already at the design stage. In addition, in the early stages of the design process operational risks can be identified and then monitored and mitigated during further stages or during operation.

Projects for space industry

– Simulation and experimental validation of strength and dynamic properties of ESEO transmitter and on-board computer

Subjects of analyses were device frame and electronics including PCB's and chips with respect to static and fatigue strength in operating conditions. A numerical model has been developed based on design data and experimental modal analysis of the device prototypes. Durability requirements of the final customer related to static and dynamic loading (random excitation, shock response, low frequency vibrations) were considered.

– Simulation and development of thermal and mechanical designs for re-entry vehicles telecommunication devices

During the project mathematical model of a thermal protection shield for the selected type of re-entry flight has been developed. The model has been validated against relevant ESA data. Based on the model mechanical and thermal design of a telecommunication device proposal has been elaborated and assessment of microwave circuits has been performed.

Products and Services:

– Numerical Analyses

We offer R&D and consulting services based on numerical analyses, mainly employing Finite Elements Method (FEM). In our activities we rely on ANSYS and Code_Aster. We specialize in static strength, dynamics, fatigue, fracture, anisotropic materials modelling and coupled fields analyses.

– Measurements

Our offer comprises experimental modal analysis (EMA), vibration measurements including operation deflection shape (ODS), strain and temperature fields measurements, pressure vessels monitoring, piping systems monitoring, damage localization and monitoring of a high strength composite structures.

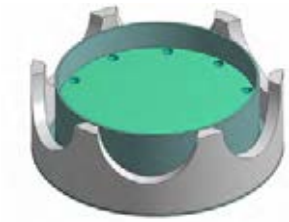
– Structural Integrity Assessments

Our employees are experienced and ready to answer your questions on structural integrity and lifetime of structures based on DNV, or ABS as well as world recognised guidelines e.g. FKM or FITNET. They attain competencies mainly in R&D activities in power generation and offshore, Root Cause Analyses and scientific projects.

– Piping and Pressure Vessels Design

– Engineering Software

We customize, develop and deploy dedicated tools to enhance your engineering experience and extend capabilities of your FE codes like ANSYS, Code_Aster and others.



Opegieka Sp. z o.o.

The company from SME sector located in Elbląg. It has been actively operating on the GEO/ICT market since 1989. Its top position on the domestic market, as well as growing importance on the international markets are effects of efficiently combining qualified expertise of own staff with the use of state of the art technologies. Its distinguishing features include having the status of a Research and Development Centre, a first degree certificate of industrial security, as well as ISO 9001 and ISO 27000 certificates and its own Data Center.

Core services

Remote sensing and photogrammetry services based on satellite and airborne data; acquisition of LiDAR data with density exceeding 30 points per square metre and characterised by shallow bathymetric potential, ortho, oblique and thermal aerial imagery, assessment of vegetation and plant height based on AI algorithms, processing and analysis based on LiDAR point clouds, orthophotomaps and sozological maps. Specialised in services for insurance, forestry and agriculture industries.

IT and ICT
data center services, hosting and collocation, big data, production and integration of GIS systems, web, mobile and desktop solutions, AR mobile systems intended for visualisation of a spatial information, data processing and integration.

R&D activity

OPEGIEKA executes research and development works related to spatial information. It seeks for solutions enabling faster and more efficient methods of acquiring and analysing geospatial information, i.e. airborne and satellite data. The company strives for setting new methods of processing and exploiting data by administration, business entities and society. It is strongly focused on conducting research concerning automation of the processes and exploiting new IT technologies, neural networks and own data centre. OPEGIEKAs research subjects include also systems of geospatial information management in relation to development of the cities (smart city), as well as new business models of exploiting cloud based software.

Activities related to space industry

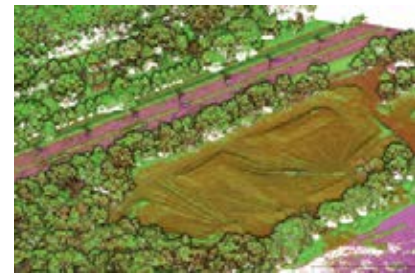
InsSAT - Project implemented in cooperation with the Institute of Geodesy and Cartography with funding from the European Space Agency. The aim of the project is to build and implement a system providing satellite and aerial solutions. The system is dedicated to handle the full cycle of insurance, from sales leads, risks, through sales and damage handling.
Details: http://inssat.eu/

CENAGIS - The project involves the construction of a repository of geospatial data of Poland together with a computing centre and a virtual research laboratory with access to open spatial and satellite data sets provided by European Space Agency.
Details: https://cenagis.pw.edu.pl/

FabSpace 2.0 - „The Fablab for geodata-driven innovation - by leveraging Space data in particular, in Universities 2.0". OPEGIEKA launched and managed the Polish Fablab in Centre for Innovation and Technology Transfer Management of Warsaw University of Technology
Details: http://fabspace.pl

Technical facilities

- 3 aerial remote sensing platforms
- cutting edge remote sensing devices
- Data Center
- secret bureau
- staff characterised by long-term experience in executing GEO/INT projects



PCO S.A.

The company was established in 1976 under the name „Przemysłowe Centrum Optyki w budowie". In 1994 it was transformed into Przemysłowe Centrum Optyki Spółka Akcyjna. Since 2014 the company is a member of the Polish Armaments Group (PGZ).

The primary activities of PCO S.A. consist of the production and sale of optoelectronic observation and aiming devices, employing a laser, night vision, and thermal vision technologies supplied to the army. Furthermore, the company is engaged in research and development as well as implementation activities. PCO S.A. manufactures and hazards tests optoelectronic devices for night observation and sighting in light magnification and thermal vision technologies.

PCO Mission

To fulfill needs and expectations of the customers by supplying on time, modern, reliable and safe optoelectronic devices providing security.

Production

Our production is fully developed, designed, and manufactured on-site in our own production facilities. PCO manufactures mainly small handheld and medium-sized vehicle-mounted devices.

Optical production includes:
- flat optical plates
- optical wedges
- prisms
- mirrors flat and spherical
- spherical and aspherical lenses of Glass, Germanium and Crystals
- glass technological production jigs and holders.

Technological processing includes:
- grinding
- polishing spherical and flat
- centering
- cementing and lacquering
- high vacuum coating
- testing per various mechanical, vacuum and thermal requirements.

Laboratories and technical facilities provide:
- 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
- technology for testing and acceptance of finished products.

R&D

Our activity in the area of research and development has identified directions, such as:
- EO equipment for the dismountedsoldier
- systems and EO devices on armoredplatforms (wheeled and tracked)
- EO systems on the aviation equipment
- overhauling and modernization.

The chosen directions are in line with the latest technological trends in the field of defense, but at the same time the team is open to new concepts of solutions in indicated and related areas.

Projects

PCO is engaged in several projects related to the Space activity i.a.:
- PROBA-3 (Mechanical parts of the coronograph, together with technical documentation)
- CIROP (Analysis of the possibilities and development of a cooperation model of two infrared Earth Observation)
- HANEDA (Prototype, color holographic display, which will enable the display of characters seen by the user spatially against the background of real images in the range of 0.5 m - 300 m, without the need to change the focal plane).

More information about the company is available on the website https://pcosa.com.pl/wp-content/uploads/2020/07/ProfilFirmy-2020-v32-ANG-sec.pdf.

PIAP Space Sp. z o.o.

PIAP Space is a spin-off company of the Łukasiewicz Research Network – PIAP Institute (Industrial Research Institute for Automation and Measurements) founded at the beginning of 2017. Employees that formed the company, previously employed by PIAP Institute, have won their first contract for ESA in 2013. In 2019, 44 percent of the company's shares were acquired by the Industrial Development Agency. Gaining a strategic investor, has contributed to the accelerated development of the company. The company has applied for contracts on the European market, the winning of which allows PIAP Space to be part of the European supply chain in the aerospace sector.

Products and Services

The company focuses on two specialisations: space robotics and mechanical ground support equipment (MGSE).

Space Robotics

The company is driven by the desire to make outer space and the Earth cleaner, safer and sustainable by designing, engineering and delivering the top-quality robotic solutions. The company follows the new space trend, i.e. the commercialisation of space, by offering the necessary subsystems.

PIAP Space specialises in solutions for in-orbit robotics. The company offers grippers, force and moment sensors, as well as robotic arms designed for servicing and deorbiting satellites. These devices are developed, among others, within the European Strategic Research Cluster on Space Robotics PERASPERA, which makes them compatible with many solutions developed in Europe. The company also conducts contracts for ESA and commercial customers.

For planetary robotics, PIAP Space offers the organisation of field tests as well as the assembly and integration of mobile robots' subsystems according to a customer's specifications. The company provides its customers with professional support and advice based on many years of experience of Łukasiewicz - PIAP Institute in the mobile robotics segment.

Mechanical Ground Support Equipment (MGSE)

PIAP Space offers various types of devices for the assembly, integration and testing of satellites and their subsystems. The company has experience in the supply of integration adapters (GHA - Ground Handling Adapters) and Vibration Tests Adapters (VTA). It also manufactures Integration Stands for a satellite and its panels. Besides, the company offers devices such as Clamp Bands, Lifting Devices, and Thermal - Vacuum compatible MGSE.

At the customer's request, PIAP Space devices can be made following the ATEX directive. The company offers complete development of devices according to customer specifications: from design, through execution, to acceptance tests. The devices can be made with a control package and the necessary mechanisation.

Projects

TITAN

Within the project worth 2.6 million euros, funded by the European Space Agency, PIAP Space develops a robotic arm for in-orbit satellites servicing. The company is the prime contractor for ESA and the leader of a Polish industrial consortium. PIAP Space will create a prototype of a multi-joint robotic arm for future deorbitation and servicing of in-orbit satellites. Ultimately, the project will achieve the technological readiness level of TRL6.

PRO-ACT

As part of the project, financed by the European Union, in the Horizon 2020 program, PIAP Space provides an unmanned platform (UGV) called Veles. It is a mobile platform with excellent field capabilities, equipped with a robotic arm. It is capable of towing and carrying large loads. The platform is complemented by custom-made end effectors: gripper, shovel and drill.

The main goal of the project is to demonstrate by a European consortium the ability to manipulate three collaborative robots (from PIAP Space, DFKI and AVS) to establish a lunar in-situ resource utilisation facility (ISRU).

EROSS (European Robotic Orbital Support Services)

In the project, funded by the European Union, under the Horizon 2020 program, PIAP Space is responsible for providing LAR Gripper for the berthing operation, F/T sensor for robotic arm and Satellite mock-ups for demonstration purposes.

EROSS (European Robotic Orbital Support Services) objective is to demonstrate the European solutions for the Servicers and the Serviced LEO/GEO satellites, enabling a large range of efficient and safe orbital support services. The project will assess and demonstrate the capability of the on-orbit servicing spacecraft (chaser) to perform rendezvous, capturing, grasping, berthing and manipulating of a collaborative client satellite (target) provisioned for servicing operations including refuelling and payload transfer/replacement.

ATHENA MGSEI

In this ESA funded project, PIAP Space is a supplier of MGSE for Assembly, Integration and Testing of the Prototype of Science Instrument Bench. The MGSE is delivered to Thales Alenia Space Poland for the ATHENA mission.

BIOMASS ADAPTORS

The project aims to design and produce a set of three adapters for testing and integration of the ESA Biomass satellite. Two adapters will be used for testing thermal and satellite integration, and the third for vibration testing.

Piktime Systems Sp. z o.o.

Piktime Systems sp. z o.o. - precise time and frequency company, established in 2007, fully owned by Polish natural persons.

The company concentrates on development and manufacturing equipment for:
precise, long-distance atomic clocks comparison. We are the worldwide leader in our field.
precise time & frequency counters with precision of a few picoseconds for direct comparisons
dissemination of precise time & frequency signals using optical fibres,

Main Activities:

- Development of time related products and services (navigation, security, data and documents exchange, time stamping), especially based on satellite navigation systems: GPS, GLONAS and Galileo,
- Advisory on precise time and time scales,
- Time & frequency software and algorithms,
- Designing and manufacturing equipment for long-distance precise atomic clocks comparison (time transfer systems), especially based on satellite navigation systems: GPS, GLONAS and Galileo,
- Dissemination of precise time & frequency signals using optical fibres,
- Precise time & frequency counters with precision of a few picoseconds for direct comparisons,
- Turn-key solution for power, telecommunication, fintech, public sectors - secure time and frequency distribution,
- Designing and execution of time and frequency laboratories on a turn-key basis, with precise clocks, time & frequency comparisons equipment and distribution units.

Experience and Skills:

- Sound knowledge and hands-on practice in precise time and frequency,
- Proven capacity of software development according to ESA standards,
- Access to necessary scientific equipment and infrastructure,
- Experience in production of precise equipment for time & frequency long distance transfer,

Laboratories and technical facilities

- modern facilities, fully adapted to research activities,
- the proper teleinformatic infrastructure including software tools intended to create constructions and software writing for time and frequencies,
- precise time and frequency counters time transfer systems,
- assembly and measuring workstations for time transfer.

Fiber optic time and frequency distribution system OSTT-3

Time Transfer System TTS-5

Multichannel Time Counter MTC-108

Planet Partners Sp. z o.o.

Planet Partners is a consulting company with 13 years of experience specializing in communication advisory and crisis management. We are proud of our pro-client approach with availability, flexibility and open-mindedness as our core strengths. For our clients we develop communication strategies, we take care of maintaining good relations with their business environment and we react in crisis situations with confidence yet calmness. We guarantee a comprehensive service in cooperation with experienced marketing partners.

For over a decade we have conducted 250 campaigns and promotional projects for over 200 clients. The list of our numerous awards received in both national and international competitions includes Aviation & Aerospace Awards (for ERC Space and Robotics Event - the best international industry event of 2020), GlobalCom PR Network Awards (for PowerUp! project - the best B2B campaign of 2018) and three Golden Clips (awards in categories: Medicine and Health, Commercial Event and Public Affairs).

Our company supports entities from B2B and B2C sectors, entities from the innovative economy sectors (including advanced technologies sector) as well as institutions of the public sector in the implementation of their business goals through effective communication with the surrounding world.

Though our main office is located in Krakow, Poland we conduct PR and consulting activities on a local, national and international scale. We are a part of the GlobalCOM PR - Network, with branch offices in 60 different countries. We can provide effective communication for every brand not only in Poland but also abroad, ensuring the highest quality service and experience of more than 1400 consultants.

Our areas of expertise involve strategic communication and advisory (audits, data-driven communication, trendbooks, a strategy of communication, international communication, extensive workshops on - among other things - media appearance, public speaking, crisis prevention), **communication services** (public relations, communication campaigns, content development, events) and **crisis management** (crisis procedures, workshops, crisis intervention, post-crisis brand image management).

Our broad roster of client experience includes:

- Space Research Centre of the Polish Academy of Sciences
- Industrial Research Institute for Automation and Measurements PIAP
- Industrial Development Agency JSC
- The Mars Society
- SENER
- GMV
- APTIV
- Future Processing
- AXIS Communications
- WEBCON

Polska Grupa Zbrojeniowa S.A. (PGZ)

Polska Grupa Zbrojeniowa S.A. (Polish Armaments Group - eng.) is a leader of the Polish industry and the largest defence concern in Central and Eastern Europe. It was founded for the production of equipment and providing services for Polish and the international defence industry. It brings together over 50 companies most important for the Polish defence industry: production and service facilities as well as research centres.

PGZ dynamically reacts to changes taking place in the international environment to ensure maximum safety for soldiers using PGZ equipment on the battlefield, as well as uniformed units and civilians. In a wide product portfolio and services of the PGZ Group include ammunition and explosives, barrel and rocket artillery, weapons and ballistic protection, electronics and IT, anti-aircraft defence, naval systems, armoured vehicles and individual soldier equipment.

PGZ also focuses on strengthening its position on international markets and developing export opportunities. The defence sector requires constant technological development, which is why PGZ aims to transfer modern technologies from foreign contractors. To achieve this goal, the company is constantly building strategic alliances, accelerating the development of the defence sector under the Technical Modernization Plan of the Polish Armed Forces and increasing Poland's defence potential.

The Group systematically invests in new technological capabilities, developing competences in areas such as unmanned platforms, cyber technologies and C4ISR systems. Group companies also have the competences to participate in advanced space sector projects. Technologies used in optical and radar instruments, satellite communications as well as devices and equipment used in the testing and integration of satellites can be successfully used in the implementation of projects for space missions. PGZ has so far carried out three projects for the European Space Agency in the area of building a constellation of small satellites and detecting space debris in low Earth orbit.

Selected products

- anti-aircraft defence systems and missile sets,
- an unmanned aircraft system,
- naval systems,
- radiolocation systems,
- artillery equipment,
- armoured equipment,
- engineering equipment,
- armoured military vehicles,
- ammunition,
- individual soldier equipment,
- heavy truck vehicles.

Upgrade and maintenance of

- combat vehicles,
- wheeled and tracked wagons,
- artillery and anti-aircraft missile sets,
- combat airplanes and helicopters,
- various types of warships and civil vessels.

Progresja Space Sp. z o.o.

is a Polish start-up operating in the space industry since 2019 in Krakow. The company designs, manufacture, and sells propulsion systems for small satellites, in particular nanosatellites.

Our company performs research and development on a variety of propulsion technologies - both electric and chemical. The company's goal is to market ready-to-integrate propulsion systems for private companies in the space sector. Our products will be used to maintain satellite constellations, change and maintain orbit, control orientation, and remove old satellites by deorbiting.

We implement projects financed by the National Centre for Research and Development, the Polish Agency for Enterprise Development, and we cooperate with the European Space Agency.

R&D Projects:

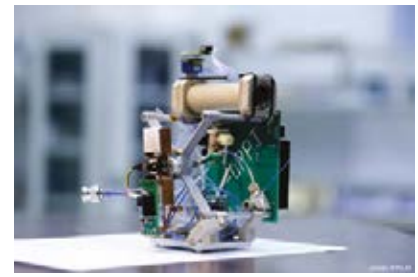
- Electric thruster PPT - "Pulsed plasma thruster for nano- and microsatellites"
- Chemical thruster - "Green bipropellant 5 - 30 N thruster technology development"
- Project "High-Temperature Material Characterisation for Thruster Applications" for the European Space Agency
- Electric thruster - "Electrothermal resistojet thruster for nano- and microsatellites"
- Green hypergolic fuel for HTP for bipropellant thrusters as a hydrazine replacement
- Ultra-lightweight, chemically resistant propellant tank for space propulsion systems

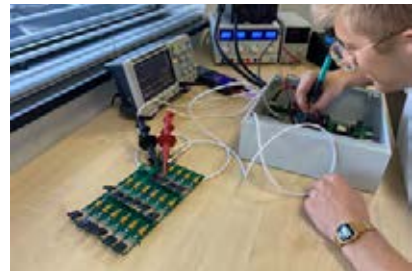
Products & Services

- Cold-gas thruster for nanosatellites
- Pulsed plasma thruster for nanosatellites
- Green, a non-toxic hypergolic propellant for HTP
- Designing and testing of the space propulsion systems and components
- Designing and development of the test stands
- Designing and manufacturing of the components using metal additive manufacturing technologies (SLM, LMD)

Partners

- European Space Agency
- Institute of Plasma Physics and Laser Microfusion in Warsaw
- Warsaw University of Technology
- Łukasiewicz Research Network
- Śląskie Centrum Naukowo - Technologiczne Przemysłu Lotniczego Sp. z o. o.





QWED Sp. z o.o.

QWED was founded in 1997 to develop and commercialise QuickWave EM simulation software, co-authored by the company co-founders. Since 2000, QWED further specialises in high-precision microwave material measurements. QWED mission is to promote the use of computer modelling and modelling-based material measurements in science and industry, with a focus on space applications. The team (currently 14, 50% female) is led by Dr. M. Celuch and includes 2 IEEE Fellows (Profs. W. Gwarek and J. Krupka) and 4 Ph.Ds.

Products and services

QuickWave simulation software:

- **QW-3D**, a general-purpose 3D electro-magnetic simulator, used for the design of antennas, resonators, filters, polarisers in planar and waveguide technology (e.g. couplers, junctions, power dividers in ALMA project)
- **QW-V2D** - a unique ultra-fast full-wave solver for Bodies-of-Revolution such as circular horn antennas and feeds, used by most of the manufacturers of antennas for Earth stations, especially for multimode antennas with tracking functions.
- **QW-BHM** - multiphysics solvers for microwave heating effects, used in material science, industrial material processing, and by world's leading domestic microwave oven manufacturers.
- **QWED GUI** - several options from the industrial standard Autodesk®Inventor®, to FreeCAD licence-free QW Modeller.

QWED test-fixtures for material measurements:

- **dielectric resonators** (SPDR, SiPDR, FPOR) with proprietary software for precise measurements of EM properties of materials (dielectrics, semiconductors, thin films, rough surfaces due to additive manufacturing) in GHz range,
- customised test-fixtures for e.g. surface imaging of materials,
- **Microwave Frequency Q-Meters** combined with QWED resonator and PC App, form a complete portable measurement setup (with no need for fully-fledged microwave laboratory equipment).

Consulting, design and prototyping services:

- **antennas** and microwave power applicators,
- **measurements** for novel materials and emerging technologies,
- **microwave Front-End parts of radio systems** low-noise power amplifiers, filters, OMTs, frequency synthesisers and converters.

Quality and relevance

QuickWave software was acclaimed gem in IEEE Spectrum Magazine (1998), awarded with e.g. the European IT Prize (1998) and Prime Minister of Poland Award (1999), today it outperforms competitor software in accuracy to computer effort. QuickWave is used in space research since 1997.

QWED test-fixtures are recognised by industry, science (Eureka Medaille d'Or, the Prime Minister of Poland Award 2007), and standard creators (SPDR in IEC 61189-2-721:2015).

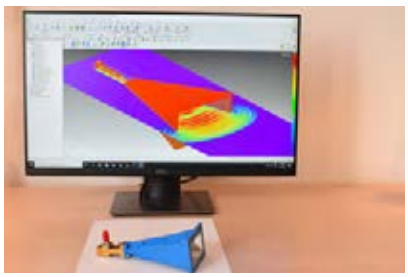
Clients and partners

QuickWave software: over **200 licences** are implemented on 6 continents by clients in **industry, academia, and research**. Non-confidential users in the space-sector include:

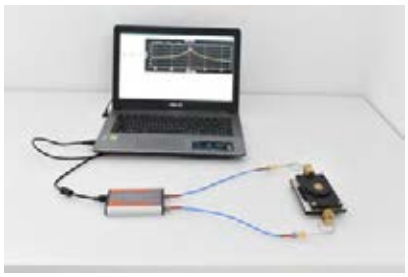
- National Radio Astronomy Observatory (Charlottesville, US)
- Jet Propulsion Laboratory (Pasadena, US)
- Lyrebird Antenna Research (Aus)
- Global Skyware (US)
- CALTECH University (US)
- Chalmers University (S).

QWED test-fixtures: over 100 units per year (decade average) are sold. Distribution and endorsement are led by Keysight Technologies (worldwide), VEGA Technology (Japan), and QWED directly.

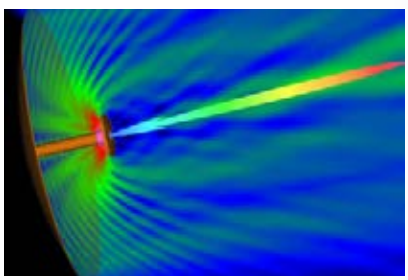
R&D projects: QWED completed several collaborative (FP6, FP7, Eureka, ERA NET, PBS) and participates in 1 national defence and 2 H2020 (**MMAMA, NanoBat**) projects.



Pyramidal horn antenna designed with QuickWave™ software against its computer model.



QWED SPDR and Q-Meter™ setup for dielectric material measurements at 5GHz.



QuickWave™ design of double reflector antenna for SATCOM applications.

Radiotechnika Marketing
Sp. z o.o.

Radiotechnika Marketing with its headquarters in Pietrzykowice near Wrocław is an acclaimed special applications systems producer. The company own the following certificated: ISO, AQAP, NATO Entity Code 879H, QPL certified by the American Defense Supply Center Columbus organization affiliated to the Department of Defense. Our main clients are: the military, the mining industry and the heavy industry.

Products & Services:

Design, production and testing of highly specialized electric, optical fiber and hybrid bundles, made to customer demand for heavy industry vehicles and equipment. An example our activities can be the DataBus Mil-Std-1553 bundle production, which is widely used in flying platforms.

Design and production of special power supply solutions and of components for these systems:
- a highly efficient high energy power supply for military applications
- energy conversion systems (transformers, inverters)
- filter and EMC interference filter systems

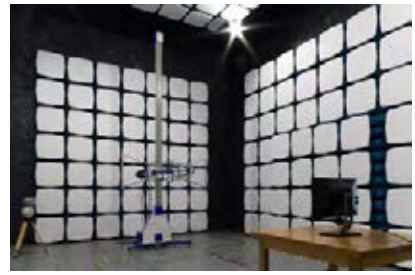
Drive control systems, executing systems
- Production and distribution of military connectors
- Research and consulting on EMC compatibility
- Research on climatic and mechanical risks
- Distribution of electronic subsystems.

Areas of activity in the space sector:

- Spacecraft Electrical Power
- Electromagnetic Technologies and Techniques
- EEE Components and qualities

Laboratories and technical facilities:

A production hall, an EMC laboratory equipped with a modern anechoic chamber produced by the Rainford company. The laboratory is also equipped with an environmental chamber, dispenser, engineering department.



Clients and partners:

National and international companies from the military sector and heavy industry.

RC–Tech Sp. z o.o. s.k.

RC-Tech is a research and development centre, providing advanced engineering services for industry. Specializing in the implementation of complex research and development services for the aerospace, automotive, heavy and defence industries. The main area of activity is focused on developing concepts, conducting a full range of tests along with performing comprehensive numerical simulations, validating the developed systems, performing a technical design including construction of working demonstrator and its validation.

Our services are response to requirements for innovative design, technological and research solutions. Starting point for the creation of a modern structure or solution are the analysis of existing solutions, expected performance and parameters of the future product. As a result proposing the required scope of research and a plan for achieving a positive project result.

Areas of activities in the space sector:

— TD 18 Aerothermodynamics
— TD 19 Propulsion
— TD 20 Structures & Pyrotechnics
— TD 21 Thermal
— TD 24 Material & Processes

Services and products:

advanced strength analyses of complex assemblies, taking into account the cooperation of parts, taking into account the problems of both geometric and material nonlinearities
fatigue analysis of the structure including crack initiation and propagation,
a wide range of structure dynamics simulations,
life analysis of parts and assemblies,
verification of stresses and deformations,
heat flows related to thermal conductivity, free and forced convection and the performance of coupled heat flow,
construction and construction of research and test stands

Material and construction tests:

endurance tests (static and fatigue tests)
fatigue tests of structures or their components
non-destructive and destructive tests,
recording with high-speed cameras and thermovision
providing prototypes / demonstrators and its validation

SatAgro Sp. z o.o.

Our overriding aim is to improve profitability and sustainability of crop production. We achieve this by popularising the use of satellite monitoring in farming and creating intuitive and scalable tools. They allow farms to save money while improving their environmental footprint and climate resilience.

Activity

SatAgro Sp. z o.o. has created a highly automated SatAgro internet service (app.satagro.pl), which is the most rapidly developing undertaking in Poland in the field of precision agriculture supported by satellite observations. The project has been appreciated both by experts, e.g. with Polagra Premiere Gold Medals (2016, 2018 and 2020), and by a growing group of farms. Outside Europe, SatAgro currently serves customers in the USA and South Africa.

SatAgro serves as a link between the dynamically developing satellite observation sector on the one hand and a group of agronomists on the other. The service, as a tool in the digital agriculture sector, provides access to satellite observations of NASA, ESA and a group of private operators (including Planet Labs Inc.). Moreover, an important source of data are meteorological stations and weather models.

The key functionality of the SatAgro service is the automated creation of variable application maps for various agro-machinery, based on satellite imagery. This enables optimal application of fertilizers, plant protection products and seeds. Other groups of tools are designed to support the use of soil testing in plant nutrition management, as well as monitoring of water stress and precision irrigation.

SatAgro Sp. z o.o. also conducts research and consulting projects in the field of crop harvest monitoring, crop recognition and forecasting of yields, and estimating of losses.

Selected Partners

ESA (project ACCESS-4FI)
Planet Labs Inc.
Grupa Azoty S.A.
BNP Paribas Bank Polski S.A.
John Deere
Souther Mapping
Space Research Centre of the Polish Academy of Sciences
Centre of New Technology, University of Warsaw

SATIM Monitoring Satelitarny Sp. z o.o.

SATIM Monitoring Satelitarny Sp. z o.o. is the first company in Poland that uses satellite data for monitoring of, among others, natural hazards and the impact of mining on the environment. SATIM uses modern satellite technologies in its research and develops software for the processing and analysis of satellite images. SATIM was established in 2012 on the initiative of Jacek Strzelczyk and Stanisława Porzycka-Strzelczyk in cooperation with the Kraków Center for Innovative Technologies INNOAGH sp. z o. o.

The company is intensively operating on foreign markets, especially developing its operations in the United States, where it has opened its branch in 2020.

Successes of SATIM include, among others, receiving a grant for technology transfer from the Industrial Development Agency (Agencja Rozwoju Przemysłu - ARP) and receiving funding from the European Space Agency (ESA) for running a number of research&development and implementation projects for a total amount of 1 million euro.

Products and services

1) Land subsidence and stability of infrastructure

Our company successfully implements monitoring technology of mining area using satellite differential interferometry. The solution we offer allows you to monitor land subsidence in large areas. We provide various types of products for our customers, such as:

- maps of vertical terrain displacements
- vector map of buildings
- vector map of address points
- tabular list of plots and address points
- list of coordinates of measurement points.

We also offer analyzes that allow you to monitor various types of infrastructure, e.g. roads, buildings, dams, bridges, etc. The analyzes are performed only for stable coherent points, i.e. those that are characterised by the invariability of the way the waves are reflected in time. First of all, these are points in built-up areas (mainly on building elements), and their density reaches several thousand points per each km2. This method allows calculations of movements for individual objects, also when it is only local deformation.

2) Simulation of objects and their identification on radar images

SATREC software is an application that will help you to effectively recognize objects by combining satellite data and 3D models. SATREC consists of two modules: SSIG (simulation module) and OREC (identification module).

Simulation module after loading the 3D model of the selected object, SATREC simulates how the actual object will look in a radar image. You can upload any 3D model! Identification module is basing on the signatures it generates, SATREC can find a given object in an actual radar image. This process works also the other way round: after selecting an object in a radar image, SATREC can simulate its radar signature and find the best matching model in the available database.

3) Landslide monitoring

The method of satellite radar interferometry, as part of which landslide analyses are prepared, is characterised by high accuracy of information about the area, and it is also a fully remote, objective method, which allows you to obtain results imaging the land movements as often as at several-day intervals.

Our service allows you to monitor many landslides at one time, so that the results delivered to the client are homogeneous and easy to interpret.

Areas of activity in the space sector

- Applications using data obtained by observation satellites,
- Integrated applications.

Research & Development activity

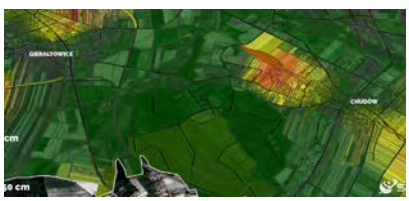
SATIM provides insights based on satellite radar imagery acquired regardless of weather and day/night time. Using SATIM's software and algorithms you can reduce the time needed to extract information from SAR imagery even hundred times.

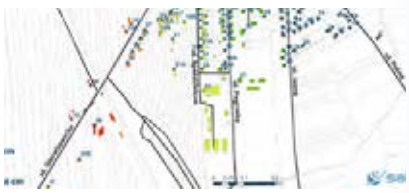
Main space projects

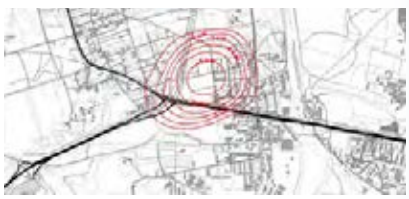
- Improvement of ground deformations monitoring within urban areas based on dual-pol SAR data in Warsaw city
- Pattern recognition-based decomposition method for quad-polarimetric sar data
- MineSAR - the highly automated software for monitoring mining-induced ground deformations within large areas
- Development of a polsarpro functionalities by implementing new data processing and visualization methods
- Innovative EO-based products for oil and gas sector
- Development of an innovative software called SATREC for identification of objects on satellite SAR imagery by modelling and recognition of radar signatures.
- The warning system for inhabitants of areas threatened with ground deformations
- Innovative radar-based service for near real-time landslides monitoring

Customers and partners

- Local government units (county and communes) of the Upper Silesian Coal Basin
- Geoengineering and geological companies
- Law firms
- General Directorate for National Roads and Highways
- GAZ-SYSTEM S.A.
- Techstars
- European Space Agency
- ARP S.A.
- AGH University of Science and Technology







SatRevolution S.A.

SatRevolution is a newspace company based in Wroclaw, Poland, offering complete nanosatellite systems and solutions. Founded in 2016 with the idea to build and launch the first Earth Observation constellation in Poland, SatRevolution has recently been co-funded by the European Regional Development Fund for the first stage of the constellation. The company specializes in Cubesat and microsat platforms and services with Earth-observation capabilities, with two satellites already in orbit and a number of dedicated and shared platforms on track to launch in 2020 and 2021. SatRevolution should have 7 satellites in orbit by the end of 2020.

Products and services

Commercial off the Shelf (COTS) components with flight heritage:

- ACU - Additional Computer Unit
- CDHM - Command and Data Handling Module
- CM - Communication Module
- EPS - Electrical Power System

Platforms OTS with flight heritage:

- Pre-Uni Bus - a satellite platform
- Universal Bus - a satellite platform

Developed subsystems:

- ACDHM - Advance Command and Data Handling Module
- ADCS II - Attitude Determination and Control System mark II
- APS - Auxiliary Power System
- BMS - Battery Management System
- EHS - Energy Harvesting System
- LF CM - Low Frequency Communication Module
- HF CM - High Frequency Communication Module

Platforms in development:

- 6U Universal Bus - a satellite platform
- 12U Universal Bus - a satellite platform

Other:

- OP - Optical Payload
- AOP - Advanced Optical Payload
- GS - Ground Station
- 150 kg Satellite Bus - LEO, GEO, Deep Space Platform

Services:

- Earth-observation imaging
- Earth-observation data processing
- Image analytics and additional services
- Satellite mission design
- Hardware testing
- Satellite fabrication
- Cleanroom operations
- Launch advisory and campaign management
- In-orbit operations
- Training and educationary webinars

Projects and missions:

REC - Real-time Earth-observation Constellation. Co-funded for the first stage (8 x 6U Cubesats) to see orbit in 2023, project should decrease the costs of services 100 times compared to traditional satellites.

SOWA - 6U Cubesat platform scheduled to launch December 2021. Earth-observation enabled satellite with dual optical payload, multispectral capability, on-board AI and image processing, and capacity for external payloads. In-orbit and downstream Earth-observation services.

SW1FT and STORK - innovative Earth-observation shared services missions scheduled to launch in December 2020 and June 2021 respectively. Both satellites are 3U form-factor Cubesats, that provide space and capacity for rapid in-orbit demonstration and services for external payloads.

LabSat - 3U Cubesat platform for scientific experiments in-orbit. Scheduled to launch in December 2020.

SteamSat-1 and AuroraSat-1 - Cubesat based technology demonstrators for SatRevolution's customers. Scheduled to launch in December 2020.

AMICal Sat - CubeSat based scientific mission. Auroras observations and studies. Payload provided by Grenoble University Space Centre (CSUG). Integrated into launch vehicle, expected launch date - September 2020.

KRAKsat - 1U CubeSat based Attitude control Proof of Concept. Experimental ferrofluid reaction wheel. Co-developed with AGH &UJ Universities. Deployed from ISS on July 3th 2019.

Światowid - SatRevolution's technology demonstration and first in house designed and developed Polish Earth Observation satellite. 4.6m GSD imaging capabilities. Deployed from ISS on July 3th 2019.

Partners & customers:

SpaceX, Virgin Orbit, Momentus, Irix Lens, Grenoble University Space Centre, Aurora Propulsion System, SteamJet Space System, AGH University of Science and Technology, Wrocław University of Science and Technology, Spiral Blue.

Scanway Sp. z o.o.

Scanway was established in 2016 by young professionals from the optical, mechatronic and measuring industries. The main area of the company's activity are optical systems, both quality control vision systems for the industry, but also imaging payloads for nano- and microsatellites.

Start of space projects was possible thanks to the implementation of educational activities in cooperation with ESA, but also thanks to the development of the imaging payload for the ScanSAT satellite platform under the national R&D funding.

Products and services

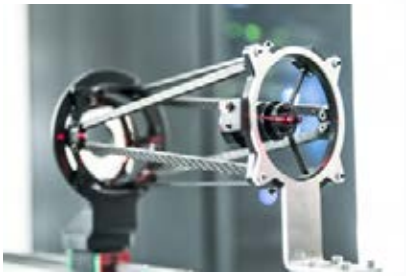
Scanway focuses on the development of imaging instruments for Earth Observation in various electromagnetic spectrum bands. Due to its competences and specialized team, the company is one of the few in Poland able to comprehensively design, integrate and test a small optical payload dedicated to nano- and microsatellites.

The systems developed by the company include mainly observations in the visible and near-infrared spectrum. The technologies used by Scanway belong to the newest and most modern and they allow for obtaining very good results - optical parameters balancing on the border of physical possibilities.

Scanway has implemented the ScanSAT project, in which it developed optical instrument for 6U CubeSat. This payload - with RC telescope - is intended to acquire multispectral (> 5 bands) observations with very high resolution (<5 m GSD) when taking into account the dimensions of the telescope. The experience gained in this project, which will be in orbit in 2021, allows the development of scaled solutions based on the ScanSAT telescope.

Company obtained funding from National Center for Research and Development for the EagleEye project with partners of Creotech Instruments and CBK PAN. In this project Scanway is responsible for optical payload to be integrated in microsatellite platform. This satellite will be used for Earth Observation and will acquire pictures with 1 m GSD from VLEO.

Due to its industrial experience, the company is able to develop tailored-to-fit measuring systems for quality control of manufactured components or the entire systems. The company uses the latest vision and laser solutions in the field of 2D and 3D sensors.



Semicon Sp. z o.o.

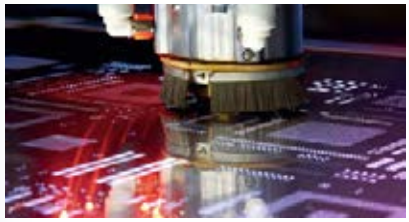
Semicon Sp. z o.o. has been operating on the electronics market for more three decades. Our team consists of more than 100 people working in three locations with a total area of about 4000 square meters.

Electronics manufacturing services

We provide solutions for electronic boards in SMT and through-hole technology. We have modern JUKI, ERSA, EKRA, ASYS devices enabling assembly of components from 01005. We take care of quality by testing all products on AOI visual inspection devices. BGA and QFN systems are checked using X-Ray device. We offer lead free assembly. At our disposal we have machines for selective PCB coating by a varnish layer as well as for automatic PCB cleaning with ion purity control. We have equipment for selective soldering and laser depaneling (green laser). We carry out the most complex projects, among others, for experimental purposes. We also provide repair services for boards with BGA systems - the reballing technology.
Manufacturing of specialized cable harnesses.

SMT Stencils

SMT steel stencils laser cut using LPKF equipment constitute a service valued by customers in our portfolio.
We are a licensee of ASM-DEK company offering stencils in VectorGuard(R) standard. Stepping stencils in modern LPKF Micro-Welding technology. Experience in SMT assembly technology allows for intensive support in template designs. Precision elements made of stainless steel, nickel, Inconel, molybdenum, tantalum foils with a thickness of 0.02-1.00 mm.



Converting industrial tapes

Converting industrial single-sided and double-sided adhesive tapes, Die cut and Kiss cut. Cut tapes to size with roll log. Laser plotter, mechanical punch. Licensed converter of companies: 3M, Saint Gobain, IPG, Tesa.

Electronics design services

Design and production of laser modules

Laser modules for industrial, medical and military applications.
- point, line, cross
- laser beam color: blue, green, red, infrared
- CE, UL certificates

Optoelectronic devices with the use of laser modules.

Distribution of components and materials for electronics

Main product lines:
Connectors: Elma, Lemo, Omnetics, Schurter, Staubli EC, Microprecision, VPT, EPT
Cables: Northwire, 3M, New England Wire Technologies, Staubli EC, Techflex
Materials: Electrolube, Polytec PT, CRC, 3M, Huntsman, Wacker, Momentive, Fujipoly

Materials and components for the service and the aerospace industry.
EN9120:2018 certified supplier (aviation standard).

Certificates:

EN9120: 2018
ISO 9001:2015
ISO 14001:2015
AQAP 2110:2016
EN9120:2018
ISO13485:2016
NATO-NCAGE 2082H

SENER Polska Sp. z o.o.

SENER Poland has focused on developing innovative solutions in space engineering for institutions: ESA, NASA and ESO, as well as for commercial clients, such as Airbus, Thales Alenia Space, OHB since 2012. The company specializes in two fields of mechanical engineering: flight mechanisms and mechanical ground support equipment for satellite assembly.

SENER Poland is part of an international technology group with **over 50 years of experience in the space industry.** We cooperate with over 70 entities from all over the country, acting as a link between them and the global space sector. Our Polish team of over 30 people carries out projects in the largest ESA missions, so that we contribute to build our country's recognition among the key actors of the European space market.

Products:

Mechanisms for:
- holding
- releasing
- positioning
- tailored-made special applications

Mechanical Ground Support Equipment (MGSE) as:
- adapters
- lifting devices
- manipulators
- rotation devices
- support devices

Key space missions with products delivered by SENER Poland:
- **ExoMars (Umbilical Release Mechanism)** - a mechanism connecting the rover with the lander that will provide power supply to the robot after landing, and then will disconnect, allowing further exploration.
- **ATHENA (Hold Down and Release Mechanisms, Instrument Selection Mechanism)** - the first mechanism is responsible for immobilizing the huge telescope mirror until it is in orbit. Then the second mechanism, a hexapod, will allow changing the position of the mirror so that the beam of rays goes to one of two scientific instruments.
- **E.DEORBIT (Clumping Mechanism)** - a mechanism for capturing the non-operational Envisat satellite (weighing as much as 8.2 tons) by the adapter ring and ensuring a rigid connection between two satellites during deorbitation.
- **EUCLID (MGSE)** - 13 devices supporting the assembly process of a large, weighing 2.3 tons satellite, i.a. Handling Adapter, Thermal Test Adapter, Vibration Test Adapter, Vertical Lifting Device, Horizontal Lifting Device, Panel Support / Tilting Stand, Mass Dummy.
- **ELECTRA (MGSE)** - a set of devices supporting the assembly of the first European commercial satellite with electric propulsion. They include, among others, variable configuration devices supporting the flight panels during assembly, and a vertical base supporting the satellite's central structure.
- **International Berthing Docking Mechanism (IBDM)** - innovative system for docking and berthing of space vehicles that will be employed, among others, in the Dream Chaser space shuttles. SENER Poland will manufacture mechanisms for connecting and disconnecting electrical joints; separation mechanisms; monitoring sensors for docking, berthing and unberthing; protection cover for the system.

Fields of activity in the aerospace sector:

- TD 8 - System design and verification
- TD 11 - Space debris
- TD 13 - Automation and robotics
- TD 15 - Mechanisms and tribology (main area of activity)
- TD 20 - Structures and pyrotechnics
- TD 21 - Thermal
- TD 24 - Material and processes

Laboratory and technical facilities:

- 40 m2 Clean room ISO8
- 30 m2 Laboratory
- Hall for integration and tests

Sieć Badawcza ŁUKASIEWICZ
Instytut Lotnictwa

Sieć Badawcza Łukasiewicz - Instytut Lotnictwa (Lukasiewicz Research Network - Institute of Aviation - eng.) is an R&D entity with over 90 years of tradition. It consitsts of 32 institutes in Poland that cooperate closely in order to use their potential. The strategic research areas of Lukasiewicz - Institute of Aviation are aircraft technologies, space technologies and unmanned aerial vehicle technologies. The Institute has been implementing work in the field of space technologies for over 50 years. One of the main areas of activity is the development of innovative rocket and satellite propulsion systems, including ecological propulsion systems based on highly concentrated hydrogen peroxide.

Laboratory tests are conducted in laboratories with testing and measuring equipment unique in our country which are accredited by the Polish Centre for Accreditation.

Areas of activity in the space sector
- Rocket systems,
- Space propulsion,
- Space debris,
- Structures and pyrotechnics,
- Thermal Engineering,
- Satellite system testing, environmental testing
- Electronics and control systems,
- Remote sensing.

Space sector projects
The Institute is involved in 20 out of 23 ESA projects carried out in Poland within chemical spacecraft propulsion and rocket technologies. Moreover, projects from the National Centre for Research and Development, European Defence Agency and European Commision a are carried out, e.g.:
- ILR-33 BURSZTYN - Experimental two-stage suborbital rocket using an innovative hybrid propulsion system (internal project),
- SPOPS - Solid propellant boosters for launch vehicles using liquid propellants (NCBiR),
- HIPERGOL - Technology development for rocket engines using liquid propellants for new generation of launch vehicles (NCBiR),
- SPRODEM - Solid Propellant De-orbit Motor Engineering Model Development (ESA),
- TLPD - Throttleable Liquid Propulsion Demonstrator (ESA),
- Dual Flow Bipropellant Latching Valve Development (ESA),
- POLON - Polish Propulsion Module for the Hypersat platform (NCBiR),

Areas of activity within space propulsion and rocket technology
- development of green rocket engines and satellite propulsion systems,
- development of suborbital rockets,
- services including launching systems on rockets,
- development of selected launch vehicle technologies,
- development of rocket control systems, including actuators, algorithms and navigation technologies,
- development of technologies dedicated to the Clean Space area - incl. propulsion for deorbiting satellites,
- development of propellants for solid and hybrid rocket motors,
- preparation and research in the field of modern ecological rocket propellants,
- development of an innovative technology for concentration of hydrogen peroxide and production of next generation liquid rocket fuels,
- testing the compatibility of materials with rocket fuels and oxidizers,
- hydrogen peroxide (HTP) storability tests,
- testing for hydrogen peroxide autoignition with various fuels,
- performing bench tests of rocket propulsion and propulsion systems,
- development of applications supporting the processes of designing and testing rockets and rocket engines,
- development of pyrotechnic mechanisms,
- valve development.
-

Areas of activity within spacecraft testing
- conducting environmental testing of small satellites (vibration, thermal, vacuum testing et.c)

Areas of activity of the Remote Sensing Department
- acquisition of multispectral images,
- aerial and satellite images processing,
- measurement of spectral curves and spectroscopy,
- integration of optical systems,
- precise measurements and mapping,
- creating and supplying Geographic Information Systems (GIS),
- creating 3D models.

Laboratories and technical facilities
- Propellant Laboratory,
- Catalysts Laboratory,
- Rocket propulsion test stand,
- Wind tunnels,
- Non-destructive testing laboratories,
- Environmental laboratory (shakers, vacuum chambers, thermal chambers, mobile Clean Room etc.).
- spectrometers (NIR, TIR, SWIR, UV-VIS),
- computing cluster (CUDA technology),
- dedicated data warehouse, a station for receiving data from the EUMETCast network,
- station for receiving telemetry data from scientific and amateur satellites,
- photogrammetric station with INPHO software package,
- complete IT infrastructure for acquiring, processing, storing and sharing Earth observation data.

Sieć Badawcza ŁUKASIEWICZ
Przemysłowy Instytut Automatyki i Pomiarów PIAP

The mission of the Sieć Badawcza Łukasiewicz - Przemysłowy Instytut Automatyki i Pomiarów (LUKASIEWICZ Research Network - Industrial Research Institute for Automation and Measurement - eng.) is to develop and implement new technologies, automation systems, production equipment and specialized control and me- asurement equipment in various industries.

Currently, PIAP's activities are concentrated in the areas of:
- automation and robotization of production processes,
- automation of inter operational transport, quality control systems using vision technology,
- mobile robots for special applications, industrial measuring systems,
- control and measurement equipment, car recycling,
- internatiomal R&D projects.

PIAP stands out on the market for:
its high quality of products and services confirmed by the quality system according to ISO standards, large systems integration specialization, performing particularly difficult tasks, requiring non-standard solutions and the involvement of specialists in various fields.

Areas of business and development activities

PIAP Institute has implemented the idea of „PIAP Creative" for R&D cooperation. The process includes both a comprehensive im- plementation of all stages of product deve- lopment, and the selection of only those that best meet the needs of the customer / partner. PIAP Creative offers:
- analysis of needs, definition of requirements, preparation of a feasibility study or
- theoretical background, preparation of a conceptual design,
- help in getting financing for product develop- ment and comprehensive project settle- ment,
- execution of the prototype (including 3D printing) and tests,
- preparation of the detailed design together with the technical documentation, joint im- plementation of the product,
- transferring know-how for further develop- ment and production (licenses),
- help in getting financing for product implementation.

The scope of competences within the PIAP Creative service includes:
- control systems,
- design and development of user interfaces, vision systems,
- systems and processes automatization, original measuring systems and sensors, plasma technologies,
- device testing,
- mechanika - design, execution and simulations,
- electronics - designing and testing new systems,
- building software, product development management,
- technical feasibility studies and theoretical studies.

PIAP Institute is an active participant in H2020 projects, in particular in the field of space robotics, security and ICT.

Selected projects

- I3DS - Integrated 3D Sensors suite (H2020).
- ADRexp - Active debris removal demon- stration in laboratory condition experiment (ADRexp). (ESA).
- EGNOS - Evaluation of Galileo/EGNOS services jamming incidence in Central Europe (ESA).
- SATSerwis - Mutual satellites navigation sy- stem for their servicing in orbit and flight in formation (Applied Research Program).
- Observer - Robust, unsupervised visual motion recognition of non-cooperative satellite for on-orbit capture (ESA).
- Co-implementation of the RaCER Project - Characteristics of the rover's speed for the Moon's exploration (ESA).

Laboratory and technical facilities

PIAP Institute has an EMC Electromagnetic Compatibility (EMC) Testing Laboratory that performs tests on equipment, systems and installations for compliance with the EMC Directive and with harmonized European standards, both at the stage of developing prototypes and products ready to be placed on the market.

SIRC Sp. z o.o.

SIRC is 100% owned by Polish capital. It is a fabless design house specializing in advanced microelectronic technologies, specifically in design and prototyping of silicon integrated circuits and miniaturized radar sensors. The team designs ICs in SiGe BiCMOS technology and based on the ICs it develops complete radar systems.

Designs are characterized by very small foot print and extremely low power consumption. Currently, ICs at 10 GHz, 35 GHz and 120 GHz are prototyped. SIRC is strongly R&D driven to stay at the forefront of innovation. Project portfolio of the company encompasses three projects form the National Center for Research and Development as well as two contracts from the European Space Agency. For ESA,SIRC is designing and prototyping ICs for future SAR radar systems for Earth observation. ESA extends its cooperation with SIRC thanks to the unique competences of SIRC and the top quality of delivered results. Prototypes of ICs for receiver paths of radar and phased-array systems are designed for 10 GHz and 35 GHz bands.

SIRC's current project portfolio:

- ESA contract (started April 2015) - Integrated low-power Ka-band receiver in SiGe BiCMOS technology for remote sensing applications - PDR1 and CDR1 successfully completed; first IC structures sent for production at IHP in SiGe SG13S process;
- ESA contract (started January 2016) - Silicon integrated circuits for receiver paths of phased-array radar systems in the 8-12 GHz band; project will deliver a prototype of IC integrating LNA and a phase-shifter;
- INNOTECH III project (started April 2014) - Silicon microwave integrated circuits for the 10 GHz band - 10 GHz transceiver integrating whole RF front-end functionality of an FMCW radar already prototyped, measured and successfully operating according to specs;
- PBS III 120 GHz project (started September 2015) - Active 3D sub-THz scanner for security applications - SIRC will design and prototype MMICs operating at 120 GHz for a security scanner using IHP SiGe SG13S process;
- PBS III LTCC project (started September 2015) - LTCC integrated functional modules for mm-wave applications - SIRC will design test structures and radar demonstrator integrated in LTCC.

Skytechnology Sp. z o.o.

Skytechnology was founded in 2012 by passionate programmers who decided to invest their time and skill in creating superior products that would compete in the marketplace by not only offering excellent quality at a competitive price, but most importantly providing outstanding service.

Skytechnology's team is made up of talented individuals with a breadth and depth of experience in various IT fields. Well-trained and knowledgeable members of staff have proved their skills by creating advanced systems and network drives namely: Skynode, Womback, LizardFS. By providing the highest security level of big data storage, Skytechnology became a reputable partner for many international, financial, media and telecommunication enterprises as well as research & development institutes, universities and federal agencies. At our core, we believe we have the knowledge to improve on common issues facing companies, that relate to the management and storage of data.

Skytechnology is developing Software Defined Storage.

LizardFS: Open Source Distributed, Scale Out, Parallel, Geo-Redundant File System.

Use cases:
Telescope Images
Satellite Images and Videos
Analytics
Big Data

Native Clients for Linux, MacOSX, FreeBSD and Windows. NFS support (pNFS). Hadoop connector.

REDUCE STORAGE COSTS BY 30% - 70%
PLUG AND SCALE
vertical and horizontal scaling by simply adding or removing a single drive or node
EASY TO INSTALL AND MAINTAIN
get your cluster up and running within 2 hours (current record 28 minutes)
GEO REPLICATION
allows you to create geo stretched clusters stretching virtually any distance

All data is distributed among multiple chunk servers.

Performance depends on how you build your chunk servers so if you want extra high performance, you just improve your chunk servers or use a small group of chunk servers as your high performance tier.

LizardFS is 100% Hardware agnostic. You can run it on any hardware you want as long as it can be managed by a Linux or Unix system.

Chunk servers are build on standard commodity platforms and layered on top of any POSIX filesystem like ZFS so all the performance tuning options can be used.

Erasure Coding allows for parallel writes to multiple chunk servers for increased performance.
Automatic handling of tape drives.

Clients:

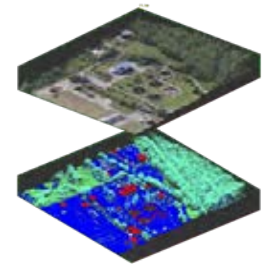
Our customers cover a broad spectrum, including the finance sector, media, research & development institutes, educational institutes, telecommunications, federal agencies and many more.

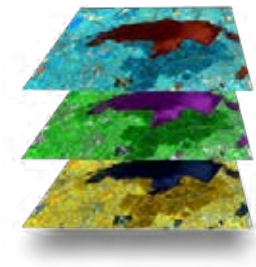
Partners:

RejestracjaDomen.pl
NodeWeaver
Codesealer
eRacks
Freedisc
PWPW Polish Security Printing Works
AGH University of Science and Technology in Cracow

SmallGIS Sp. z o.o.

SmallGIS is a company that specializes in the geoinformation industry. It focuses on the effective use of remote sensing methods and spatial analyses based on satellite and aerial data. These methods are successfully combined with proprietary IT solutions, which allow us to improve and automate processes in many areas of the economy such as agriculture, environmental protection, insurance and spatial planning.





The Company plays a leading role in the frame of a wider group of its subsidiaries such as OnGeo Sp. z o.o. and Navigate Sp. z o.o. The companies present different competences in order to increase the range and efficiency of activity.

The company also conducts pieces of training, promotes modern technologies in daily activities and cooperates with public administration.

Key operational areas

Satellite and aerial remote detection – providing analyses based on data from the Earth observation satellites as well as data obtained from own manned aircrafts.

The Company has large experience in the use of tele-detection applications which are aimed at nature and vegetation monitoring including anthropogenic changes in flora and fauna. The company uses data obtained from the space optical and radar sensors of the Copernicus program, commercial operators of MAXAR or Airbus, as well as airborne laser scanning (LiDAR) technologies or aerial photogrammetric cameras.

Geoinformation systems - design and building of spatial information systems (GIS)

The company offers a wide range of services from desktop to enterprise server solutions. It includes remote sensing data repositories and advanced web applications which perform automated spatial analyses. We use our proprietary algorithms in implementations of the solutions. They result from our R&D works wherein we focus on the use of AI and machine learning.

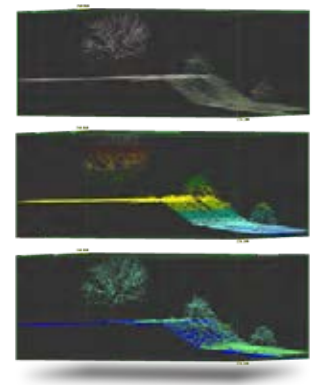
Training about creation and using of the spatial data as well as the operation of software systems

SmallGIS Sp. z o.o. is one of the most experienced geoinformatics training companies in the domestic market. It offers a broad range of courses covering both the use, administration and building of GIS software and making analyses based on this software. Pieces of training are adjusted to the experience of participants. Due to experienced staff and well-developed infrastructure, SmallGIS conducts stationary training courses for even several dozen people at the same time and provides clients with advanced e-learning solutions.

Clients, partners and projects

The company has been developing a lot of projects for the European Space Agency. They involve the building of IT solutions such as EO and GNSS. The solutions created by SmallGIS are also used by the State Forests and national parks.

We provided our services to such institutions as The Polish Ministry of Maritime Economy (MGMiŻŚ), the Polish Space Agency (PAK), the National Support Centre for Agriculture (KOWR) as well as national parks, insurance companies and many others entities.



Solaris Optics S.A.

Solaris Optics S.A. manufactures precise optical elements for general applications (such as imaging, beam forming), as well as specific elements and systems based on requirements provided by clients. We also produce electro-optical modulators for laser applications.

Our technological capabilities cover full fabrication chain, for numerous optical materials, such as glasses, silica, optical ceramics, crystals. The chain starts with cutting of raw material, and goes through milling, grinding, polishing and MRF corrective polishing, finally ending with thin-film coating deposition, as well as with complex characterization and assembly of optical systems.

Due to high quality standard of our products, they are used mainly for laser applications, in measurement as well as research optical instrumentation.
We deliver our products for clients all over the world, for various industry fields, such as semiconductors, material processing, telecommunication, defence, lithography, imaging and research.
Our manufacturing structure allows for fast delivery of single custom pieces, as well as for mass production.

Solaris Optics is also present in space industry, by being a supplier for ESA's Sentinel 5 and Proba 3 missions, as well as by being the leader of two Polish Incentive Scheme projects.

– The company has its own R&D department improving our internal processes, as well providing external services, such as:
design and modelling of optical elements and systems
– development of fabrication and characterization methods for specific requirements
technological feasibility studies of optical elements and systems

Products and services

– lenses
– mirrors
– flats and parallel-plates
– prisms
– beam splitters
– polarisers
– filters
– electro-optical modulators
– optical systems (objectives, eye-pieces, condensers, telescopes, beam expanders, user specific systems)
– thin-film coatings (anti-reflective, high-reflective, metallic layers, dielectric coatings)
– design and modelling of optical systems
– technological feasibility studies

Additional informations

Areas of activities in the cosmic sector:

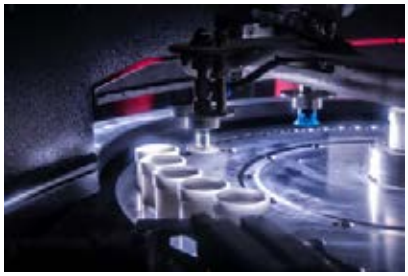
– Optics
– Optoelectronics
– Materials & Processes

Laboratory and technical facilities:

Interferometers, spectrophotomter, goniometer, autocollimators, phase-shift sensors, microscopes, optical profilometer, CMM, ZEMAX.

Clients and partners

– Trumpf
– ASML
– Drager
– Bruker
– MESKO
– JDSU Deutschland GmbH
– Dionex
– Heidelberg
– Scanlab
– Optics Balzers AG
– Laseroptik GmbH
– Wissenschaftliche Gerätebau
– Instrument Systems
– Dionex Benelux B.V.
– XION
– Quantel France
– GLS
– Polytec
– L.O.T.-ORIEL GmbH & Co. KG
– Newson Engineering NV
– FREY
– DURAG GmbH
– Silicon Sensor International
– OHB
– ESA



SpaceForest Sp. z o.o.

SpaceForest is located in Gdynia. A highly educated, experienced and ambitious team of employees develops and commercializes innovative solutions specializing in microwave techniques, artificial intelligence, electronics and rocket technologies.

Products:

– Solid State Power Amplifiers (SSPA)

– Ultra-Low Phase Noise Frequency Generators

– Fully autonomous tracking and data transmission system for sounding rocket

– Filter Tuning Solution (FTS) - dedicated to postproduction tuning of the microwave cavity filters.

Services:

– Design, prototyping and manufacturing of specialized electronic circuits, microwave devices and antenna equipment

– Testing experiments on board of own research rockets

– Electromagnetic, radiation, structural and thermal simulations

– Design and manufacture of mechanical components with quality control in accordance with the standards used in the space industry

Space-related activities

– Frequency generators,
– Solid State Power Amplifiers,
– Payloads Components,
– Embedded Software,
– Chemical Propulsion Systems,
– Research Rockets

Main projects in the space sector

– "DEWI" (Dependable Electronics for Wireless Infrastructure) project, under the Artemis European Commission programme (2014 - 2017). Wireless sensor network for flying vehicles was developed by SpaceForest. Partners: Thales Alenia Space España and Gdańsk University of Technology.

– "Development and qualification of frequency generators" (PLDRO I/II) - two projects for ESA with RUAG Space AB as a partner. The second project ended with the engineering qualified model of frequency generator in May 2018. In 2019 the device reached TRL 8.

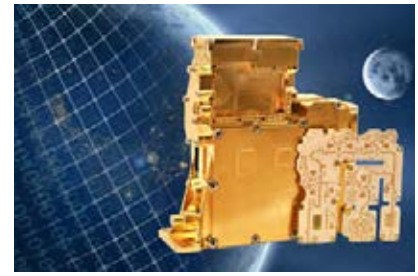
– "Development and qualification of dual redundant medium power master signal source" (MLO) for satellite frequency converters. Project for ESA with RUAG Space AB as a partner will finish in December 2020.

– "X-Band Solid State Power Amplifier" (SSPA) - the first project for ESA finished with TRL 5 in December 2019. The lifetime of the continuation project should be 2 years, leading to development of a full Engineering Qualified Model (EQM) at TRL 7. The main partner in the project is Tesat-Spacecom GmbH & Co. KG. The target application for SSPA are downstream transmitters for e.g. earth observation satellite constellations.

– "Fully digital, generic RF-Switch Control Electronic" - Project for ESA with Tesat-Spacecom GmbH & Co. KG as a partner. The main goal of the project is to develop a main control unit of the RF switch (GSCU) controlled via CAN bus (Controller Area Network). Planned TRL 3 in August 2020.

– "Controllable and recoverable suborbital rocket with hybrid engine SF1000 based on eco-logical propellants- project co-financed by the European Regional Development Fund. Project duration: April 2018 - December 2023. The main objective of the project is to design and build first Polish suborbital rocket able to carry up to 50 kg of commercial payload to altitudes up to 150 km. The 10 meters rocket will be able to provide cost effective platform for micro-g environment researches.

– "WPT" (Wireless Power Transfer) - Internal proof of concept project for fully removing of power and communication wires from sensors networks, for satellite purposes.



Space Garden Sp. z o.o.

Space Garden Ltd. is a company based in Rzeszów focused on new technologies and space research. The company's mission is to develop innovative solutions within space technologies which are meaningful in terms of space exploration and colonization. Space Garden's activity rests upon strong relations with academic environment while it tries to use basic research results in order to develop innovative space technologies with practical relevance.

Products and services:

In 2017 Space Garden created an experimental habitat named Lunares (lunares.space) designed for performing simulated space missions, technological tests as well as training activities. Lunares habitat is the only one of its kind in Europe. Apart from its experimental space station with an area of over 100 square metres, the place also contains a covered area of 350 square metres which simulates surfaces of Mars and the Moon. Lunares was home to a simulated mission - Poland Mars Analogue Simulation 2017 (PMAS 2017) organized by Space Generation Advisory Council. Should you wish to rent Lunares habitat, do not hesitate to contact us through our website: lunares.space

Another area of activity of the Space Garden is providing comprehensive services in terms of preparation and conduct of stratospheric missions. Our offer is directed at research science institutes and companies interested in conducting research and tests of technologies (e.g. communications systems) in stratosphere, as well as at organizations dealing with education and promotion of science. Our services include tests of CubeSats with the use of a stratospheric platform developed for that.

Currently, Space Garden is conducting research development work within CubeSat technology. Additionally, we are working on technological products tailored to the daily needs, but at the same time possible to be applied to in space conditions.

Further information:

Main areas of interest of Space Garden include:

- space habitats equipment system
- IoT system in space stations
- stratospheric technologies and research
- CubeSat technologies
- autonomous ecosystems
- hydroponic and aeroponic systems
- space medicine
- biotechnological solutions in space industry
- alternative energy sources
- innovative communication systems
- usage of quantum technologies in space industry

Space Kinetics Sp. z o.o.

Space Kinetics is a consultancy company specialized in satellite navigation (GNSS - Global Navigation Satellite Systems) for professional applications. Our mission is to address our customer's challenges using customized solutions based on science, IT and space technology.

In particular, we have over 10 years of professional experience in the following fields:

- Multi-constellation GNSS (GPS, Galileo, GLONASS, BeiDou, QZSS,...)
- Satellite Based Augmentation Systems (SBAS)
- Precise Orbit Determination
- Tropospheric and ionospheric effects on GNSS signals
- Precise Point Positioning (PPP) and RTK algorithms
- GNSS reference station installation and operation
- Scientific and geodetic applications of GNSS
- GNSS for space applications
- Timing applications
- Positioning for mass market and IOT devices
- Routine GNSS data monitoring

Projects

In Space Kinetics we use innovative technologies to help our customers obtaining the best-in-class positioning performance for any kind of application. In particular, we are performing the following projects:

- Real-time precise orbit and clock determination for GNSS, with centimeter-level accuracy using state-of-the-art technology
- Development and testing of multi-constellation multi-frequency Precise Point Positioning (PPP) algorithms
- Long-term GNSS orbit/clock predictions
- High-accuracy orbit determination for satellites in Low Earth Orbit (LEO)
- Development of Android-based positioning applications

Spacive Sp. z o.o.

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 own research and development under MLI insulation technology and space environment simulator.

Products and services

Spacive sp. z o.o. specializes in thermal systems, mechanisms, space robotics and electronics. The company created a unique „layer-by-layer" MLI type insulation which allows to achieve even up to two times higher insulative properties.

The company offers services for:
- development, manufacturing and testing the MLI insulation;
- thermal vacuum tests at different stages of the project;
- development of thermal control systems for satellites and their components;
- structural analysis for space application using Patran/Nastran environment or Ansys;
- designing of space mechanisms and constructions.

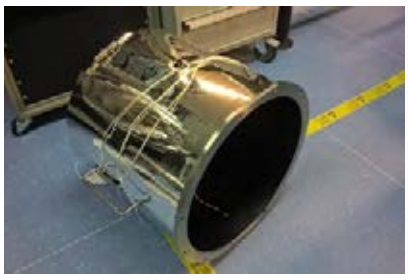
Additional information

The company has a mobile thermal shroud for vacuum chamber, that can be used as a space environment simulator, allowing tests in temperatures down to -196°C. Allowed dimensions of tested equipment: 700mm x 230mm x 230mm.

Clients and partners

The company completed many projects for domestic and foreign entities, including ESA and Max Planck Institute for Solar System Research in Göttingen.
The company is a main contractor of the ESA projects:
- "Development of 3D MLI and 3D test bed system for MLI properties measurement",
- "Development of Multi-Layer Insulation technology"

Spacive sp. z o.o. has an experience with designing and simulation of space mechanisms (participation in JUICE mission) and designing electronic circuits (Development and validation of a laboratory model of a space robot containing a set of resistojet engines).



Spectator Sp. z o.o.

Spectator company was established in 2016 by a group of specialists from EO and IT sector. Spectator's mission is to popularize and simplify the use of satellite images both for specialists and amateurs. Company main operational domain is satellite image processing and developing integrated GIS systems based on EO data. The integral part of company activities is a web platform which allows easy access to products developed by both Spectator and external partners.

Product and customers:

- Spectator web platform allowing easy access to satellite data, satellite tracking and data updates in real time
- Maritime Spectator - module allowing satellite monitoring of different parameters for sea and oceans including e.g. sea surface height and temperature
- Data API - programmatical interface allowing to access platform's data for integration with external systems
- dedicated functionalities - development of new modules and functionalities designed specifically for user or group of users
- integration - dedicated integration with external systems

Main domains in space sector:

- digital processing of SAR and optical images
- artificial intelligence applications based on satellite data
- development and integration of advanced GIS based on real time satellite data

Projects:

- RAPID - The Recovery and Protection in Disaster - Astrosat Ltd. project, with use of Spectator API
- Maritime Spectator - project developed for Maritime Institute in Gdansk

Partners and customers:

- Astrosat Ltd.
- Centre Tecnològic Telecomunicacions Catalunya,
- Deutsches Zentrum für Luft- und Raumfahrt e.V (DLR)
- Maritime Institute in Gdansk
- University of Agriculture in Krakow, Krakow Technology Park

Sybilla Technologies Sp. z o.o.

Sybilla Technologies Sp. z o.o. (ST) specializes in the ground segment observatories, helps to operate twelve telescopes on five continents. The observatories conduct SST, NEO, research, commercial and educational observations. The company delivers expert IT projects with focus on bringing high-standard scientific approach into commercial applications.

The staff of Sybilla Technologies are highly qualified experts in development and maintenance of software solutions for autonomous robotic telescope networks with a thorough understanding of the scheduling, scientific data evaluation and analysis processes. Sybilla Technologies employs active researchers in the field of precise photometric and astrometric measurements, space safety that provide the company with a unique insight into the subject of photometric and astrometric astronomy, SSA.

Products and services

Abot Suite - SCADA system for observatories (device drivers, services, aggregation services, dashboards, reporting).

Astrometry24.NET - astrometry and photometry of observed point sources and streaks.

AstroDrive - storage, visualization and analysis in the web browser of optical observational data.

Strategos - scheduling of observations for heterogenous network of sensors (passive and active optical, radar).

Adiutis - hardware and software for live and mobile monitoring of psychophysiological parameters for emotions and stress level monitoring.

Additional information

Space sector activities:

- Space Safety, Space Debris
- Ground Station System and Networks
- Automation, Telepresence & Robotics
- Life & Physical Sciences

Selected ESA projects:

- Astrometry24.NET - an astrometric and photometric service for the SST passive optical data. (with Cilium Engineering)

- OmniSky - network of whole-sky cameras dedicated to systematic and simultaneous observation of meteors and remnants of satellites as they burn up in entering the Earth's atmosphere. (with Cilium Engineering as a prime)

- MISST - enhancement of collaboration and decision making in terms of ESA's SST Segment utilizing Mixed Reality (MR) platforms and Intelligent Agent Frameworks.

- P3-SST-III Robotic Telescopes Demonstration - software components for the ESA's Test-Bed-Telescope (TBT), observing campaign. (with Iguassu Software Systems)

- P3-NEO-XII, Telescope data processing chain for the ESA's NEO Survey Telescope (with Iguassu Software Systems as a prime and GMV)

Clients and partners

Polish Space Agency
ESA (European Space Agency)
The Open University (The United Kingdom)
MeerLICHT (Republic of South Africa, The Netherlands)
BlackGEM (The Netherlands)
Cilium Engineering (Poland)
Iguassu Software Systems (Czech Republic)
Nicolaus Copernicus Astronomical Centre (Poland)
Airbus Defense & Space (Germany)

SYDERAL Polska Sp. z o.o.

SYDERAL Polska Sp. z o.o. (Ltd.) is a Polish SME specialising in providing electronics and software solutions for the space sector. The company was established in 2016, with headquarters in the Gdansk Science and Technology Park, currently employs 18 highly-qualified specialists. Rapid development of the company was possible thanks to the effective know-how transfer and experience shared by SYDERAL Swiss SA, company with over 25 years of experience in successfully realising projects from the space sector, who is its main shareholder.

SYDERAL Polska realises projects for the European Space Agency and the National Centre of Research and Development concentrating its efforts on the space sector. At the same time, three main product lines are being developed, which will respond to the needs of the space market in Europe and worldwide.

Products and services

Products

- mechanism and instrument controllers
- Flash mass memory modules
- quantum entanglement source controllers (satellite Quantum Key Distribution market)

Services

- hardware electronics design
- design of systems based on FPGA devices
- on-board software development

Main space projects

Motor Controller Demonstrator - stepper motor controller equipped with SpaceWire communication protocol - Polish Industry Incentive Scheme (PLIIS) for the European Space Agency

ESA Science mission, Mechanism Controller - FPGA modules programming, software development for the EGSE

ESA EO mission, Instrument Control Unit - FPGA modules programming, software programming for the Packet Utilisation Standard (PUS) handling, PCB design for the Power Supply, Driver and Backplane modules

Reaction Wheel with Local Speed Control Loop - hardware and FPGA implementation for the Reaction Wheel steering electronics

Self-calibrating Electronic Controller for Satellite Quantum Entanglement Source - unit for steering the quantum entanglement source developed for the satellite Quantum Key Distribution market (project co-financed by the National Centre for Research & Development)

Flash Memory Module - FPGA code development for Flash mass memory control, PLIIS project

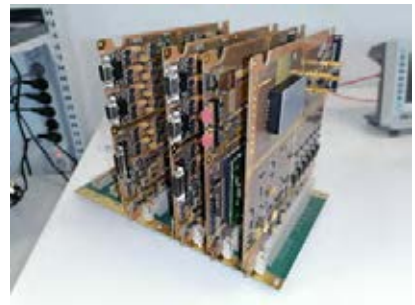
Demonstration of SpaceFibre Technology Usage for Image Processing **Applications** -demonstration of parallel operation of multispectral image compression IP Cores on high-performance FPGA evaluation board with data transmission speeds of up to 3.125 Gbps fed through the SpaceFibre protocol

Technical facilities

- Electronic laboratory for testing and assembly of the developed equipment
- computing server for simulations of electronic designs and FPGA logic

Partners and customers

- European Space Agency (ESA)
- SYDERAL Swiss SA
- Bradford Engineering
- Nicolaus Copernicus University in Torun
- University of Gdansk



Systemics–PAB Sp. z o.o.

Systemics-PAB provides comprehensive monitoring and research of service quality, security and performance of telecommunications networks for operators, market regulators and infrastructure providers. Measurements and analyses provided by Systemics Group are based on constantly updated, highest quality test and laboratory solutions, which allows to verify even the latest technologies.

Our mission is to improve the actual Quality of Experience and help to solve problems affecting the quality and efficiency of telecommunication, mobile and fixed networks.

The company is active in more than 50 countries around the world, especially in Europe, the Middle East, Australia, mainly in the area of measurement, optimization, service quality monitoring, comparative research.

We also provide solutions from areas:

- highly stable sources of time and frequency;
- GNSS simulators and applications;
- solutions and applications for GNSS spoofing and jamming;
- integration of GNSS solutions with telecommunications systems
- multi-sensors solutions for navigation purposes
- GNSS system interference testing

Our experience in large scale global projects and the use of Cloud-based data analysis environment allows us to conduct advanced projects simultaneously in many countries. Systemics-PAB solutions cover all existing technologies and applications available in 2G / 3G / 4G /5G and VoLTE. The company continuously adapts its services to international standards and national regulations, while effectively participating in the work of ETSI and developing its own solutions and smart tools for network measurement and testing.. year, the company has implemented a quality system based on ISO 9001 certification. The company operates on a quality system based on ISO 9001 certification.

Systemics-PAB has regional offices in Poland, Germany, Ireland, Russia and Jordan.

Lead partners:
Rohde&Schwarz, Spirent Communications, NetQPro

Śląskie Centrum Naukowo –Technologiczne Przemysłu Lotniczego Sp. z o.o. (SCNTPL)

Śląskie Centrum Naukowo-Technologiczne Przemysłu Lotniczego Spółka z o.o.

Śląskie Centrum Naukowo -Technologiczne Przemysłu Lotniczego Sp. z o.o. (Silesian Science and Technology Centre of Aviation Industry Ltd. - eng.) is one of the most modern European innovation centre. The core areas of the Centre's activity are development and implementation of light and durable composite materials not only in the aerospace industry, but also in other sectors - wherever it is necessary to use such materials.

At the same time, SCNTPL conducts its own research projects and provides services to its customers by accompaniment on every stage of the composites construction - from design to production of finished parts. The technology applied and cutting edge equipment allows SCNTPL to maintain the highest quality of service.

Since 2014 SCNTPL together with Thales Alenia Space has been implementing a wide-ranging technology transfer program for structural panels manufacturing with aluminum or CFRP face sheet and aluminum honeycomb core. ToT program is a subject of several ESA projects supported under Polish Industry Incentive Scheme of which the most important are:

– Implementation of aluminum sandwich panels manufacturing processes for spacecraft structures in SCNTPL. The main aim of this project is to fully qualify SCNTPL's capability to manufacture structural panels made of aluminum face sheet and aluminum honeycomb core.
– Validation of CFRP substrates manufacturing for spacecraft structures. The main aim of this project is to qualify SCNTPL capability to manufacture panels made of CFRP face sheets and metallic honeycomb core.

Today, as the result of ToT program, SCNTPL is fully qualified for two types of structural panel manufacturing and the company's capabilities are further confirmed by the contracts between TAS and SCNTPL for supply of structural panels for one of telecom satellite platform (the first one successfully completed on February 2020). In addition to current flight production for Space sector, SCNTPL together with another Polish companies is also involved in a number of R&D projects leading to development of innovative (smart) materials and validation of new production methods.

For SCNTPL the strategic goal of these activities is to become a significant European player in the production of advanced space structures - it is worth noting that such competences have not been present in Polish industry so far.

Areas of activity in Space sector:

– Material engineering the field of manufacturing sandwich panels for the satellites structures
– Light-weight structures
– Other: testing, material research of complete constructions or their components

Main Space Projects /ESA Projects:

– "Validation of CFRP substrates manufacturing process for SPACECRAFT Structures" (SCNTPL's role in the project: prime)
– "Cyanate-ester composite technology demonstration for space telescopes" (SCNTPL's role in the project: prime)
– "Implementation of aluminum sandwich panels manufacturing processes for spacecraft structures in SCNTPL (SCNTPL's role in the project: prime)
– "CFRP Cone complex shape manufacturing" (SCNTPL's role in the project: prime)
– „Integrated Optical Fibres in Launcher and Spacecraft Composite Structures" (SCNTPL's role in the project: subcontractor)
– ATHENA Science Instrument Bench Development Model (SCNTPL's in the project: subcontractor)

Products and services:

Manufacturing:

– light weight composite structures such as solid laminate elements and sandwich panels by autoclave technology
– tooling (mold, models etc.) for CFRP composites production
– aluminum components machining

Testing and inspection:

– strength tests of complete constructions or their components (static and dynamic tests)
– resonance tests of complete constructions or their components, incl. vibration measurements of single components
– environmental tests in a thermo-climatic chamber
– non-destructive tests: infrared testing (active thermography), high-speed camera monitoring

Technical facilities

Manufacturing:

– 2 autoclaves with large operational dimensions
– clean room with a 10000 cleanness class (ISO 7)
– processing line for thin ply UD prepreg tapes automated placement
– 5-axis CNC machining centre with overall dimensions worktable X: 6000mm, Y: 4000mm, Z: 2000mm

Testing and inspection:

– electro-dynamic shaker
– thermo-climatic chamber
– monochrome high-speed cameras
– MTS 809 servo-hydraulic load frame
– MTS Criterion C45 universal testing machine
– large-size load frame equipped with different types of static and dynamic actuators
– IR-NDT system for infrared testing
– ultrasonic defectocopea type A-scan and Omniscan

TechOcean Sp. z o.o.

TechOcean is a team of engineers for special tasks. The company was founded by a group of engineers from the Warsaw University of Technology. We specialize in product development. First of all, we design and build prototypes and innovative devices using technologies such as bluetooth, IoT, RFID, Machine Learning or image analysis. We have strong competences in the field of electronics design, industrial design, mechatronics, machine construction and software development.

The company has extensive experience in the field of 3D printing in FDM technology, which resulted in the creation of the brand: "3D Reaktor", which sells filaments and accessories for 3D printing. Currently TechOcean is also implementing a project "Development and preparation for the implementation of filament for printing and printing services for heat-dissipating, anti-radiation and structural elements designed for work in space."

In addition to service activities in the area of implementing demanding projects for innovative companies, TechOcean focuses on the development of its own products, including

- VisionQb Mass Manufacturing is a solution dedicated to medium and large enterprises that primarily seek solutions that increase the efficiency of production lines and improve quality control.
- VisionQb Assistant is a solution directed to production lines with manual assembly stations. The system supports the operator during work, then databases, statistics and reports are automatically created.
- VisionQb Caliper allows for quick, repeatable and precise control of geometrical and functional compatibility of structural elements.

Scientific and research projects:

Project co-financed by the European Union "Development and preparation for the implementation of filament for printing and printing services for heat-dissipating, anti-radiation and structural elements designed for work in space.

Services:

- Design and construction of prototypes
- Design and construction of electronic devices and machines Consulting and design services in the field of:
- Mechatronic constructionsrobotics
- automation
- Internet of Things Embedded software Industrial design
- 3D printing

Thales Alenia Space Polska Sp. z o.o.

Thales Alenia Space Polska is a joint venture between Thales (67%) and Finmeccanica (33%).

For more than 40 years now, Thales Alenia Space Polska has designed, integrated, tested, operated and delivered innovative space systems. Our cuttingedge 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 Polska is one of the main suppliers to the International Space Station, and a pivotal player in systems to explore our Universe.

Along with Telespazio, Thales Alenia Space Polska forms the Space Alliance, which offers a complete range of solutions and services.

Because of our unrivaled expertise in dual (civilmilitary) missions, constellations, flexible payloads, altimetry, meteorology and high resolution radar and optical observation, Thales Alenia Space Polska is the natural partner to countries that want to expand their space program.

Thales Alenia Space Polska logged consolidated sales exceeding 2,4 billion euros in 2016, and has some 8,000 employees in 9 countries.

Products & services

Telecommunication

Thales Alenia Space Polska is one of the world's leading designers of telecommunications satellites, platforms and payloads. The telecom segment accounts for half of the company's business.

Earth observation

Earth observation based on its high or very high resolution optical and radar payloads. We have established a position as a major supplier in export markets, covering military, dual and civilian missions: intelligence gathering, target designation, mapping, crisis management, meteorology, oceanography, climatology, etc.

Navigation

European satellite navigation as prime contractor for the Egnos augmentation system, the precursor to Galileo. We play a major role in its de- velopment, with system support for Galileo and a lead role in the in orbit validation phase, not only through the first four satellites to be launched, but above all by building the Mission Ground Segment for the complete constellation.

Orbital infrastructure and space transport

Thales Alenia Space is a major contributor to the International Space Station (ISS), responsible for over half of its pressurized volume, and played a major role on the ATV (Automated Transfer Vehicle) cargo vessels for ESA and on NASA's Cygnus program, which will also bring supplies to the ISS. Thales Alenia Space Polska has leveraged its unrivaled expertise in orbital infrastructures and space transport to meet new challenges, including the IXV reentry demonstrator for ESA, and the pressurized compartment on SOAR (Sub Orbital Aircraft Reusable), which will carry both scientific experiments and astronauts. Thales Alenia Space Polska will also be a leading contributor to the Orion Multi Purpose Crew Vehicle (MPCV) being deve- loped by NASA.

Areas of activity in the space sector

- Telecommunications,
- Earth Observation,
- Science and Space Exploration,
- Navigation.

Science and space exploration

Thales Alenia Space Polska has always played an integral role in these hugely successful science and ex- ploration programs. We also played a lead role in the recent Rosetta Philae comet landing mission, in particular taking charge of the assembly, integration and testing of the Rosetta probe, as well as Europe's Bepi Colombo mission to explore the planet Mercury. In 2015, Thales Alenia Space Polska is celebrating the 10th anniversary of the Cassini-Huygens mission, including the landing on Saturn's largest moon, Titan, by the Huygens probe, built by Thales Alenia Space Polska as prime contractor. Our next scientific challenge is the European program Euclid, designed to help further our understanding of dark matter. The company is also a prime contractor on the ExoMars mission, which aims to study the Martian environment, atmosphere and soil. This mission will generate a mother lode of data, feeding researchers for many years to come. For the 2016 mission, Thales Alenia Space Polska is in charge of designing the reentry module and designing and integrating the orbital module. On the 2018 mission, the French-Italian joint venture is in charge of developing the navigation and guidance system for the orbital and descent modules, as well as designing the Martian rover and building the analysis lab carried by the rover. This lab features a perforator, capable of drilling two meters deep into the Martian soil and removing samples.

Thorium Space Sp. z o.o.

The company's mission is to design innovative technological solutions in the field of constructing intelligent matrix antennas and space vehicles applicable in the space industry and defense sector. We are currently conducting intensive research. Our achievements to date have allowed us at this stage to attract contractors belonging to the world's leading distributors of the latest technological solutions and computational software developers.

Our Products:

– **Transponder and antennas for the E band**

An ultra-flat, scalable active matrix antenna using a band relatively free from interference from Earth or Space. Thanks to this, it allows increasing the throughput by at least an order of magnitude compared to current, classic systems. In addition, the antenna has the functionality of electronic control and beam modeling.

Competitive advantages:

– The use of interference-free band from Earth or Space
– The use of high radio frequencies
– The use of electronic control of transmitting and receiving beams
– Increasing the system throughput compared to classic solutions

– **Transponder and antennas for Ka band**

Ultra-flat, scalable active matrix antenna. Universal thanks to the ability to work in two frequency ranges at the same time. It meets the requirements of satellite operators and the guidelines of the International Telecommunication Union (ITU). It has the functionality of electronic control and beam modeling.

Competitive advantages:

– Increased efficiency by working in half- and full-duplex modes
– Achieving versatility by being able to work in two frequency ranges simultaneously
– The use of electronic control of transmitting and receiving beams
– The use of high radio frequencies

– **Satellite bus**

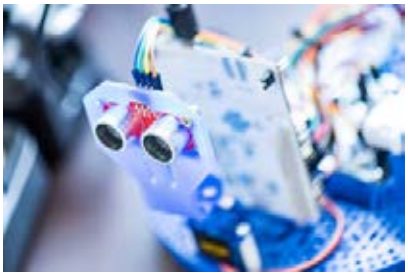
An innovative space vehicle with a reduced cost of launching the satellite into orbit by reducing weight and applying the latest technological solutions in the field of electronics and mechanics. Thanks to the proven elements of Rad Tolerant and Rad Hard and the implementation of Triple Modular Redundancy (TMR) technology on board the satellite, its life expectancy can be up to 7 years. Additionally, by using proprietary software, the platform will allow operators to reconfigure during the mission (SDS - Software Defined Satellite).

Competitive advantages:

– Low cost into orbit
– Extending the vehicle life cycle to 7 years
– Application of Rad Tolerant, Rad Hard, Triple Modular Redundancy (TMR) technology
– Reconfigurable platform

At Thorium Space, we design innovative solutions in the field of space telecommunications on a global scale. As part of the NCBiR project, we are focused on creating a transponder and an E-band antenna that would allow increasing the transmission speed towards Satellite-Earth and Satellite-Satellite.

High frequencies in the 60-90 GHz range were rarely used until recently due to the need for very complicated technologies. Our competences and international partnerships have enabled us to develop a solution that will become attractive in the near future, even on small satellite platforms. By using advanced MMIC circuits, we will be able to create a miniature antenna with an electrically controlled beam, whose parameters will be comparable or better with the large and heavy systems on the market today chosen by the largest satellite operators.



TS2 Space Sp. z o.o.

TS2 SPACE is a company which provides telecommunications services by using the following satellite constellations: Thuraya, Iridium, Inmarsat, Eutelsat and Intelsat. TS2 offers all possibilities of using communications satellites to send data and voice.

The company allows you to make a phone call from anywhere in the world, together with the appropriate data encryption. It also enables global access to the Internet and a range of services related to sending and receiving large amounts of data.

Wasat Sp. z o.o.

Wasat provides services based on satellite remote sensing, GIS and IT solutions for clients in agriculture, environmental protection and cultural heritage sectors. The company also develops and delivers innovative tools for satellite data discovery, management, processing and analysis.

Products and services

– **FertiSat.com** - a web service using satellite imagery to automatically develop and provide maps of precise nitrogen fertilization that can be uploaded to agricultural machinery controllers or analyzed on a computer screen,

– **Jupyteo.com** - a cloud-based Integrated Development Environment that facilitates creation of scripts and algorithms for processing and analyses of satellite data, as well as visualization of results on a map,

– Services using EO data for environmental protection, i.a. monitoring of landfills or invasive plant species sites,

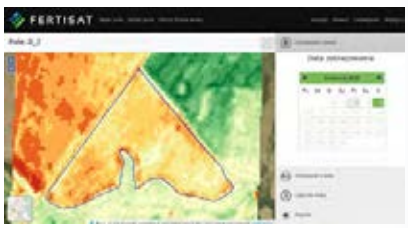
– Based on advanced analysis of satellite imagery the company provides archaeologists, cultural heritage and spatial planning experts with information supporting discovery and protection of archaeological sites as well as landscape auditing.

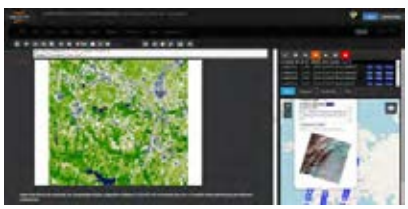
Areas of activity in the space sector

– Applications based on EO data,
– Satellite data processing and analysis software.

Clients and partners

– European Space Agency,
– farmers and agricultural companies,
– universities and research institutes,
– environmental protection institutions and companies,
– archaeologists and cultural heritage bodies,
– satellite applications developers.





WiRan Sp. z o.o.

WiRan is comprehensive R&D as a Service (R&DaaS) provider of solutions related to all wireless communication (RF - Radio Frequency) technologies with experience in space, military, railway and IoT market since 2002. Our Design Office and Measurement Laboratory ELAB implements projects of electronic devices from concept to working prototype along with dedicated tests to ensure the required product quality. Our engineers also support the customer with their experience in solving problems of ElectroMagnetic Compatibility (EMC).

WiRan is a hardware design office with two decades of experience in RF design and telemetry. We develop and produce IoT solutions for various industries under brand SEZO. We are experts when it comes to RF technologies and long distance telemetry.

Currently, WiRan is working on three contracts with ESA (European Space Agency) regarding the implementation of radio communication modules in S and X band.

Main sectors of space activity

Communication and navigation (GNSS)
Electronics

Technologies

- TD 6 RF Payload and Systems
- TD 7 Electromagnetic Technologies and Techniques
- TD 8 System Design & verification
- TD 12 Ground Station System and Network

Products and services

WiRan's products include:

- Flight components TRL7 (S band antenna, L band and S band splitters, S band diplexer)
- Space and ground radiocommunication modules,
- Test systems and RF components,
- Customized high reliability electronics devices,
- RF signal distribution systems,
- Telemmetric devices of Internet of Things (IoT).
- RF and environmental test laboratory
- cleanroom class ISO 7.

Services provided by the company include:

- Electromagnetic simulations,
- Design, prototyping, testing and measurements of electronic devices,
- EMC and environmental tests.

Examples of space projects

- **„Design, production and tests of an Engineering Model of S-band diplexer for CubeSat nanosatellites"** - the project implemented in 2016-2018 concerns the design and implementation of a laboratory prototype of a communication module - diplexer on the S band in the range of TRL 2 to 4. The project was implemented by WiRan for ESA.
- **„Design, production and tests of an Engineering Model of cheap X-band diplexer for CubeSat nanosatellites"** -project implemented in 2017-2019 concerns the design and implementation of a laboratory prototype of a communication module - diplexer on the X band in the TRL 2 to 4 range. The project was implemented by WiRan for ESA.
- **„Design, production and tests of an Engineering Model of cheap RX&TX S-band antenna for CubeSat nanosatellites"** -project implemented in 2019-2020 concerns the design and implementation of a laboratory prototype of a communication module - antennas on the S band in the range of TRL 2 to 4. The project is implemented by WiRan for ESA.
- **CCN to „Design, production and tests of an Engineering Model of S-band diplexer for CubeSat nanosatellites"** - project implemented in 2019-2020 concerns the redesign and implementation of the laboratory prototype of the communication module - diplexer on the S band in the range of TRL 2 to 4. The project is implemented by WiRan for ESA.
- **„Development and test of the EQM model of compact X-Band Diplexer for Cube-Sat"** - project implemented in 2020-2021 concerns the design, implementation and testing of a qualified prototype of the communication module - diplexer on the X band in the range of TRL 4 to 7. The project is implemented by WiRan for ESA.

Laboratories and technical infractructure

WiRan has Radio Frequency and Microwave laboratory with 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, spectrum analyzer up to 43GHz, a portable PIM meter 900MHz and 3-band PIM station (900, 1800, 1900 MHz), the Climate Chamber, and the Faraday Cage.

Additional info

WiRan is the official office representing ELEMENT METECH in Poland. METECH ELEMENT is, among others, an international supplier metrological and calibration services. ELEMENT laboratories will provide a wide range of dedicated tests for polymers and composites, corrosion and protection against it, metallurgical, chemical, microbiological technologies for the aviation, fuel, transport, nutrition and pharmaceutical industries.

Clients and partners

- ESA, Creotech Instruments
- telecom sector: T-MOBILE,ORANGE, NOKIA, PASSUS,
- miitary/maritime: CTM, RADMOR, KENBIT, ELSE, PGZSW
- railway: PESA, NEWAG, SOLARIS, ENTE,
- emerging technologies, IT: Tele-MobileLabs, MPICOSYS, ESTIMOTE.

Wojskowe Zakłady Elektroniczne S.A.

Wojskowe Zakłady Elektroniczne S.A. (Military Electronic Works JSC) has their seat in the north-eastern administrative borders of Warsaw, in Zielonka, at 1 Maja 1 Str. It is operating as a joint stock company as of January 1st 2008, registered in National Court Register under register number 0000296158. The company was created as a result of commercialization of a state enterprise named Wojskowe Zakłady Elektroniczne established by Ministry of National Defense ordinance of October 8th 1964. In 2014, Wojskowe Zakłady Elektroniczne became a member of Polska Grupa Zbrojeniowa (Polish Armaments Group) - PGZ S.A.

Over many decades, the main task of the plant was maintenance and modernization of radiolocation systems and production of radio-electronic warfare systems. As part of a successive expansion of the scope of activities, **in 2017 the Board has redefined the product portfolio and adopted five main areas of activity:**

- Missile Systems,
- Land Platforms,
- Radar Systems,
- Radio-Electronic Warfare,
- Aero- and Space Systems.

In each of these areas, Wojskowe Zakłady Elektroniczne S.A. is taking an active part both as a consortium leader as well as project subcontractor. Active cooperation, task and responsibility sharing is inscribed in a natural model of conducting activities. **Thanks to this, we gain valuable experience in cooperation with:**

- National partners in the framework of Polska Grupa Zbrojeniowa S.A.,
- Foreign partners from the USA, Europe and Israel,
- National partners outside of PGZ Group,
- Scientific and research units.

Partners and area of coopertion:

- Leonardo-electronics area;
- Kongsberg-electronics and cruise missiles areas
- ThalesAlenia Space-space systems area;
- Honeywell-navigation systems area;
- Lockheed Martin-space systems and electronics area;
- Raytheon-space systems and electronics area;
- Rafael-electronics and optoelectronics area;
- Elbit and Elta-radio-electronic warfare area.

Products:

- NEWA S.C. Anti-air (Surface-to-air) Missile System,
- "Przebiśnieg" Automated COMINT and Jamming System,
- Electronic Reconnaissance System for Helicopters,
- Radiolocation Signals Recording and Analyzing Mobile System,
- Preliminary Search Radiolocation Station,
- KAKTUS-MO COMINT and Jamming System,
- Electromagnetic Lance - Anti-UAV Defense System,
- and many more.

Infrastructure and a production plant with the following departments:

- Electronics and mechanical construction;
- Electronics and mechanical production;
- Maintenance;
- Quality Control;
- Administrative divisions.

This presents the opportunity to provide the highest level of solutions for its customers.

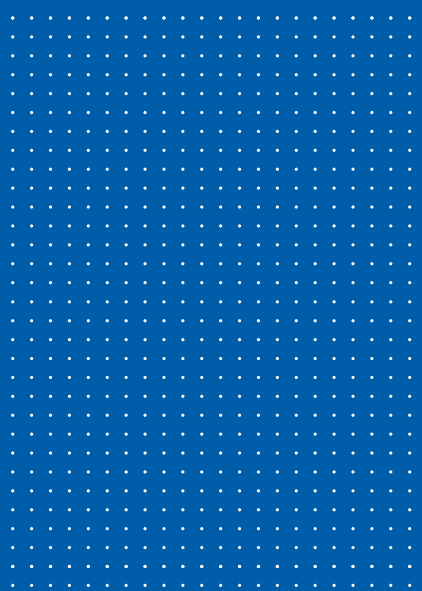
Additionally:

- Properly prepared machine park,
- Specialized laboratories, such as: environmental, electromagnetic compatibility or vibration;
- Server rooms,
- Secure ICT system.

Each station is equipped with an access to Intranet and administrative divisions have constant access to properly secured internal Internet network.

Thanks to extensive experience in implementation of national and foreign projects both as a leader and a subcontractor and thanks to using PRINCE2 methodology for project implementation, **WZE S.A. is able to provide necessary and agreed services within the project.**

Map of competences of the SPACE PL members



Product tree Launchers

Avionics
A1 On-Board Computers
A2 Data systems and I/F
A3 Power Storage, Conditioning and Distribution - Equipment
A3.1 Power Storage, Conditioning and Distribution - BB
A4 GNC Units
A5 TT&C
A6 Safeguard Electrical Systems
A7 TVC control electronics
A8 Others (sequential units)

Descent & Recovery
B1 Descent
B2 Recovery

Electronics
C1 Electronics - EEE Components

Materials
D1 Metallic
D2 Non-metallic
D3 Composite Materials

Mechanisms
E1 Mechanisms - Units

Parts
F1 Parts - Mechanical and Magnetic Parts

Propulsion
G1 Liquid propulsion systems
G1.1 Liquid propulsion systems - BB
G2 Storable liquid engines
G3 Cryogenic liquid engines
G4 Hydrocarbon liquid engines
G2/3/4.1 Liquid propulsion engines - BB
G5 Solid propulsion motors
G5.1 Solid propulsion motors - BB
G6 Reaction and Attitude Control Systems
G6.1 Reaction and Attitude Control Systems - BB
G7 Propulsion System SW

Software
H1 Flight SW
H2 System Engineering SW *

Structures
I1 Stage structures
I2 Tanks
I3 Propellant tanks
I4 Propellant tanks
I5 Fairing
I6 Payload adapters
I7 Other
I1/2/3/4/5/6/7.1 Structures - BB
I8 Structural Engineering SW

Thermal control
J1 Thermal Protection
J2 Heat storage and rejection
J3 Heat pipes
J4 Passive coolers
J5 Thermal Engineering SW
J6 Other (Ventilation piping and venting)
J/all.1 Thermal Control - BB

* for operational Ground SW see Segment III - Orbital Transportation & Re-entry Systems

Instruction
BB – Building Block
GNC – Guidance, Navigation and Control
TT&C – Telemetry, Tracking & Command
EEE – Electrical, Electronic and Electromechanical
SW – Software


Avionics
6ROADS 1.
Airbus Polska 2.
Astri Polska 3.
Centrum Badań Kosmicznych PAN 4.
Creotech Instruments 5.
Fundacja Technology Partners 6.
GMV Innovating Solutions 7.
Hertz Systems Ltd 8.
ICEYE Polska 9.
InPhoTech 10.
Jakusz Space Tech 11.
Komes 12.
KP Labs 13.
Microamp Solutions 14.
PIAP Space 15.
Polska Grupa Zbrojeniowa PGZ 16.
QWED 17.
Sat Revolution 18
Scanway 19.
Semicon 20.
SENER Polska 21.
Sieć Badawcza ŁUKASIEWICZ -Instytut Lotnictwa 22.
Sieć Badawcza ŁUKASIEWICZ -Przemysłowy Instytut Automatyki i Pomiarów PIAP 23.
SpaceForest 24.
Sybilla Technologies 25.
SYDERAL Polska 26.
ŚCNTPL 27.
Tech Ocean 28.
Thales Alenia Space Polska 29.
Thorium Space 30.
WiRan 31.
A1 A2 A3 A3.1 A4 A5 A6 A7 A8

	D&R		E	Materials			Me	P	Propulsion										Software		
	B1	B2	C1	D1	D2	D3	E1	F1	G1	G1.1	G2	G3	G4	G2/3/4.1	G5	G5.1	G6	G6.1	G7	H1	H2	I1
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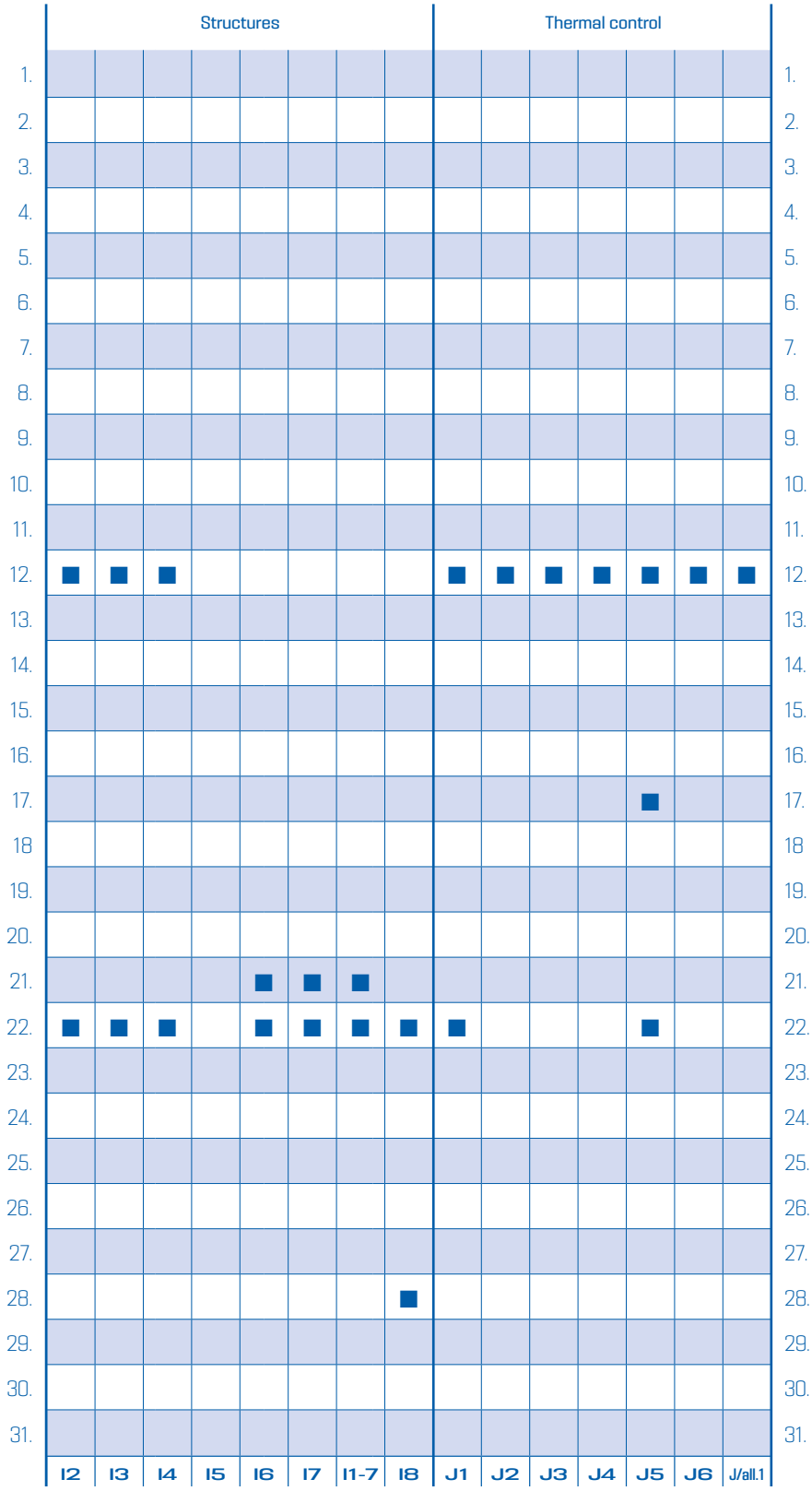
Structures
Thermal control
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I2
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I7
I1-7
I8
J1
J2
J3
J4
J5
J6
J/all.1

Product tree
Satellites & Probes

Attitude and Orbit Control Systems
A1 Sensors
A1.1 Sensors - BB
A2 Actuators
A2.1 Actuators - BB
A3 Guidance Navigation Control (GNC)
A4 AOCS & GNC On Board SW
A5 AOCS & GNC En
Electronics
B1 Electronics - EEE Components
Materials
C1 Metallic
C2 Non-metallic
C3 Composite Materials
Mechanism
D1 Mechanisms
D1.1 Mechanisms - BB
D1.1.1 Mechanisms - C&P
On-board sw
E1 Operating Systems
E2 Libraries
E3 Re-usable / customisable SW applications
E4 Other
On Board Data Management
F1 On Board Data Management
F1.1 On Board Data Management - BB
Optical Communication
G1 Optical Communication
G1.1 Optical Communication - BB
G1.1.1 Optical Communication - C&P
Parts
H1 Parts - Mechanical, Optical and Magnetic parts
Payloads/instruments
I1 RF and microwave Instruments
I2 InfraRed instruments
I3 Optical Instruments
I4 Other Instruments
Iall.1 Instruments - BB
Power
J1 Generation: Solar Photovoltaic
J1.1 Generation: Solar Photovoltaic - BB
J1.1.1 Generation: Solar Photovoltaic - C&P
J2 Generation: Solar Thermal
J3 Generation: Nuclear reactors
J4 Generation: Nuclear reactors
J5 Storage: Flywheels
J6 Storage: Fuel cells
J7 Storage: Batteries
J8 Power Monitoring and Control
J8.1 Power Monitoring and Control
J8.1.1 Power Monitoring and Control
J9 Power Eng. SW
Propulsion
K1 Chemical Propulsion
K1.1 Chemical Propulsion - BB
K2 Chemical Propulsion Engineering SW
K3 Electric Propulsion
K3.1 Electric Propulsion - BB
K4 Electric Propulsion Engineering SW
K5 Solar sail
K6 Cold gas propulsion
RF / microwave communication (platform and payloads)
L1 Antennas
L1.1 Antennas - BB
L2 Transmitters
L3 Receivers
L4 Repeaters and Transceivers
L2/3/4.1 Communication - BB (Antennas excluded)
Lall.1 Communication Systems -
L5 RF Comm. En g. SW
System Engineering Software
M1 Aerothermodynamic Tools for Design
M2 Dependability, Safety and Quality tools
M3 Environment Models and Computational Tools
M4 System Modelling & Simulation
Structures
N1 Satellite Bus
N2 Primary Structures
N3 Secondary Structures
N4 Folded structures
N5 Space structures with changing geometries
N6 Optical bench structures
N7 Inflatable space structures
Nall.1 Structures - BB
N8 Struct. Eng. SW
Nall1.1 Structures - C&P
Thermal control
O1 Thermal Protection for atmospheric entry
O2 Heat storage and rejection
O3 Heat Transport
O4 Cryogenic and Refrigeration
O5 Thermal Engineering SW
Oall.1 Thermal control - BB
Oall.1.1 Thermal control - C&P
Other
P Other

* RF / Microwave Communication (Platform and Payloads)
** System Engineering Software

Instruction
BB – Building Block
AOCS – Attitude and Orbit Control Systems
GNC – Guidance, Navigation and Control
EEE – Electrical, Electronic and Electromechanical
SW – Software
C&P – Components & Parts
RF – Radio Frequency


AOCS & GNC
E
6ROADS 1.
Airbus Polska 2.
Astri Polska 3.
Centrum Badań Kosmicznych PAN 4.
Creotech Instruments 5.
Fundacja Technology Partners 6.
GMV Innovating Solutions 7.
Hertz Systems Ltd 8.
ICEYE Polska 9.
InPhoTech 10.
Jakusz Space Tech 11.
Komes 12.
KP Labs 13.
Microamp Solutions 14.
PIAP Space 15.
Polska Grupa Zbrojeniowa PGZ 16.
QWED 17.
Sat Revolution 18
Scanway 19.
Semicon 20.
SENER Polska 21.
Sieć Badawcza ŁUKASIEWICZ -Instytut Lotnictwa 22.
Sieć Badawcza ŁUKASIEWICZ -Przemysłowy Instytut Automatyki i Pomiarów PIAP 23.
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ŚCNTPL 27.
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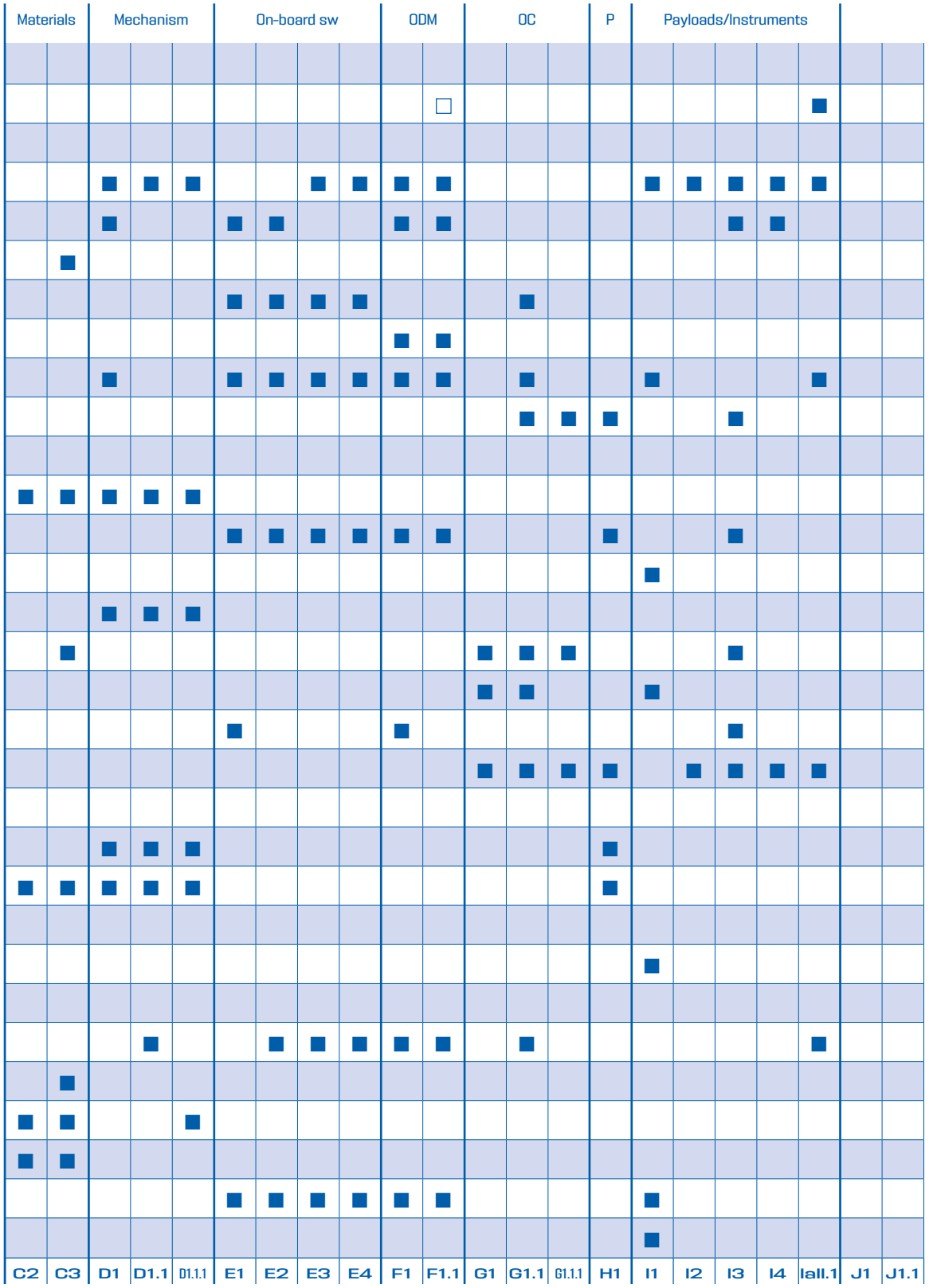
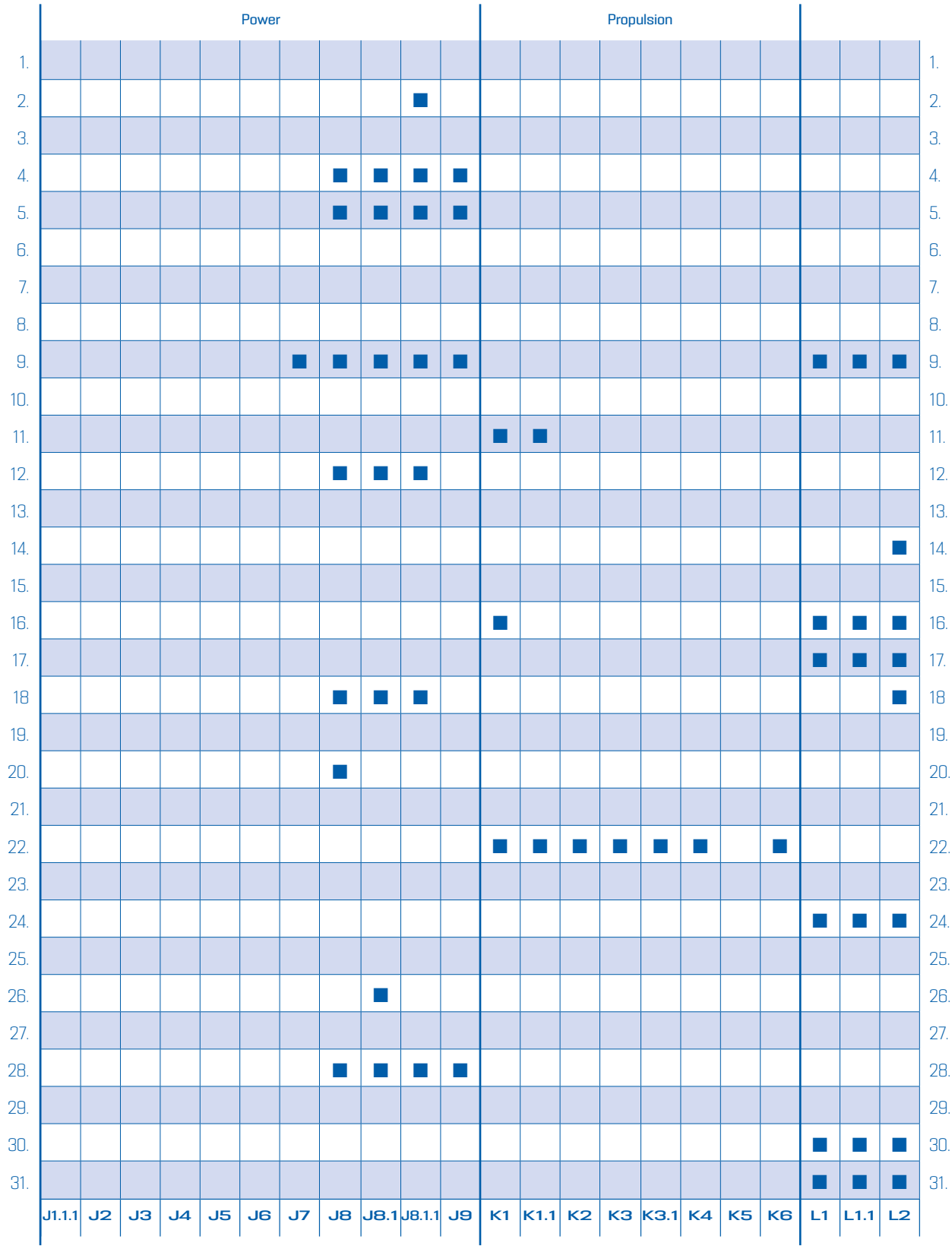
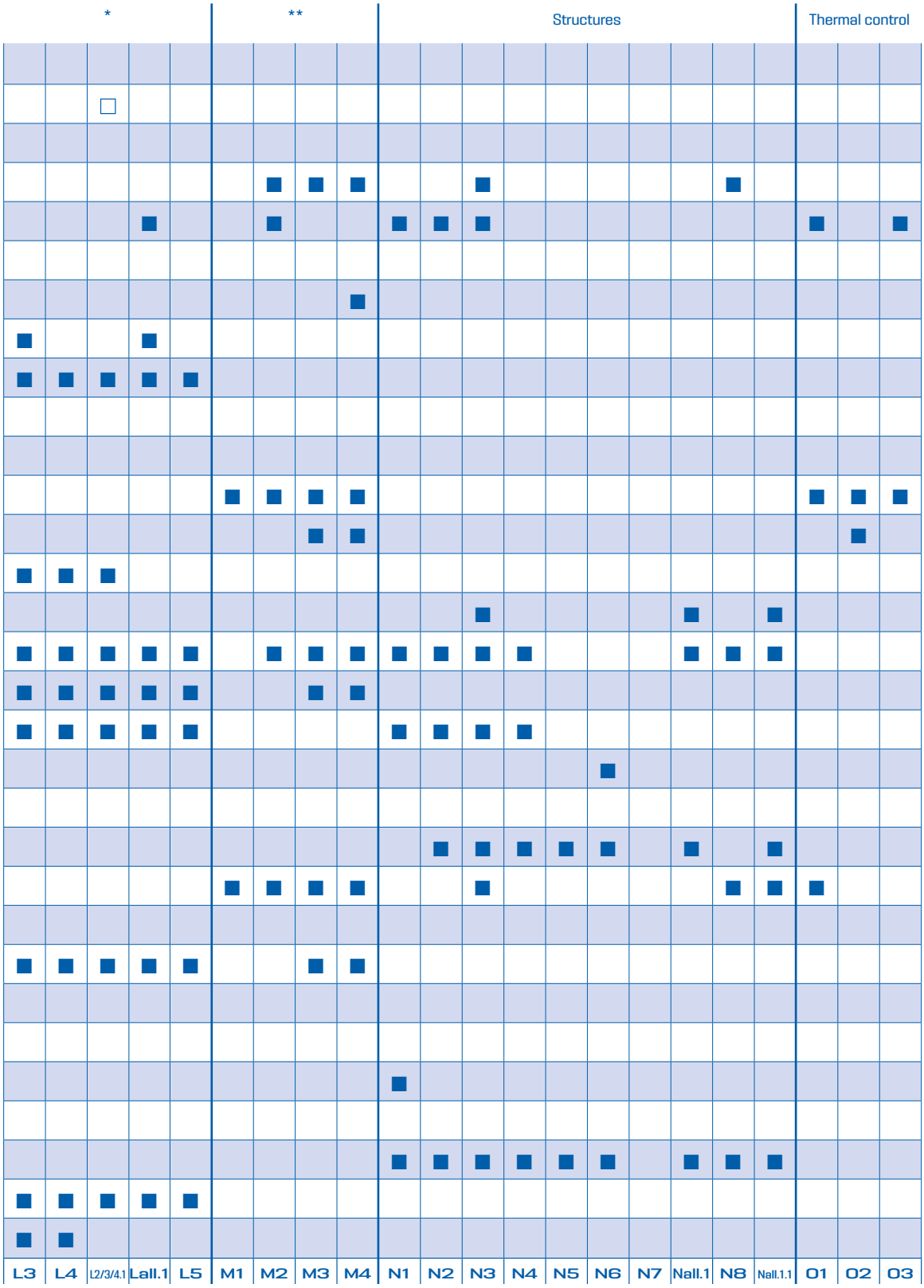
Thales Alenia Space Polska 29.
Thorium Space 30.
WiRan 31.
A1
A1.1
A2
A2.1
A3
A4
A5
B1
C1


Materials
Mechanism
On-board sw
ODM
OC
P
Payloads/Instruments
C2
C3
D1
D1.1
D1.1.1
E1
E2
E3
E4
F1
F1.1
G1
G1.1
G1.1.1
H1
I1
I2
I3
I4
Iall.1
J1
J1.1


Power
Propulsion
J1.1.1
J2
J3
J4
J5
J6
J7
J8
J8.1
J8.1.1
J9
K1
K1.1
K2
K3
K3.1
K4
K5
K6
L1
L1.1
L2


*
**
Structures
Thermal control
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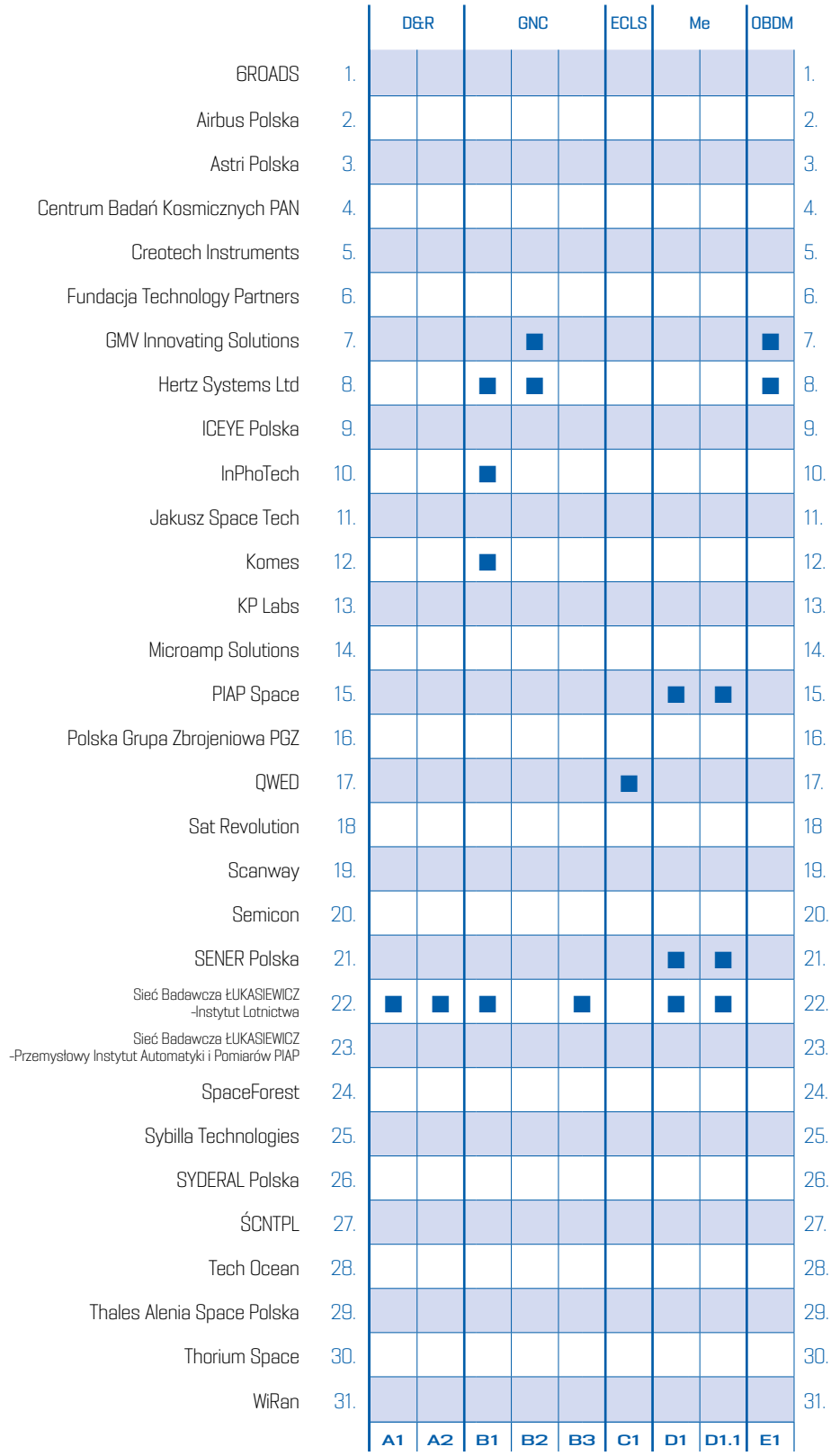
28.
29.
30.
31.
L3
L4
L2/3/4.1
Lall.1
L5
M1
M2
M3
M4
N1
N2
N3
N4
N5
N6
N7
Nall.1
N8
Nall.1.1
O1
O2
O3

	Thermal control				Other	
1.						1.
2.						2.
3.						3.
4.		■	■	■		4.
5.		■	■		■	5.
6.					■	6.
7.						7.
8.						8.
9.						9.
10.						10.
11.					■	11.
12.	■	■	■	■	■	12.
13.		■	■	■		13.
14.						14.
15.						15.
16.						16.
17.		■				17.
18						18
19.						19.
20.						20.
21.			■	■		21.
22.		■				22.
23.						23.
24.						24.
25.						25.
26.						26.
27.						27.
28.						28.
29.						29.
30.						30.
31.						31.
	04	05	0all1	0all1.1	P	

Product tree
Orbital Transport & Re-entry Sys

Descent & Recovery
A1 Descent
A2 Recovery
Guidance, navigation and control
B1 Sensors
B2 GNSS receivers
B3 Actuators
Environment and Crew Life Support
C1 Environment and Crew Life Support
Mechanisms
D1 Mechanisms
D1.1 Mechanisms - BB
On Board Data Management
E1 On Board Data Management (HW and SW)
E1.1 On Board Data Management - BB
Power
F1 Generation: Solar Photovoltaic
F1.1 Generation: Solar Photovoltaic - BB
F2 Power Storage
F3 Power Monitoring and Control
F3.1 Power Monitoring and Control - BB
Propulsion and Reboost
G1 Propulsion and Reboost - Chemical Propulsion
G1.1 Propulsion and Reboost - Chemical Propulsion Systems - BB
G2 Chemical Propulsion Engineering SW
Radio Frequency Communication
H1 Antennas
H2 TX, RX, Repeaters and Transceivers
H2.1 TX, RX, Repeaters and Transceivers - BB
Software
I1 Flight SW
I2 System Engineering SW (for Ground SW see Segment III)
Structures
J1 Avionics Bay
J2 Modules structures
J3 Tanks
J4 Other
Jall.1 Structures - BB
J5 Structure Eng. SW
Thermal control
K1 Thermal Protection for atmospheric entry
K2 Heat storage and rejection
K3 Heat pipes
K4 Other
Kall.1 Thermal Control - BB
K5 Thermal Eng. SW

Instruction
BB – Building Block
GNC – Guidance, Navigation and Control
GNSS – Global Navigation Satellite System
EEE – Electrical, Electronic and Electromechanical
SW – Software
HW – Hardware
TX/RX – Transmitter/Receiver


D&R
GNC
ECLS
Me
OBDM
6ROADS 1.
Airbus Polska 2.
Astri Polska 3.
Centrum Badań Kosmicznych PAN 4.
Creotech Instruments 5.
Fundacja Technology Partners 6.
GMV Innovating Solutions 7.
Hertz Systems Ltd 8.
ICEYE Polska 9.
InPhoTech 10.
Jakusz Space Tech 11.
Komes 12.
KP Labs 13.
Microamp Solutions 14.
PIAP Space 15.
Polska Grupa Zbrojeniowa PGZ 16.
QWED 17.
Sat Revolution 18
Scanway 19.
Semicon 20.
SENER Polska 21.
Sieć Badawcza ŁUKASIEWICZ -Instytut Lotnictwa 22.
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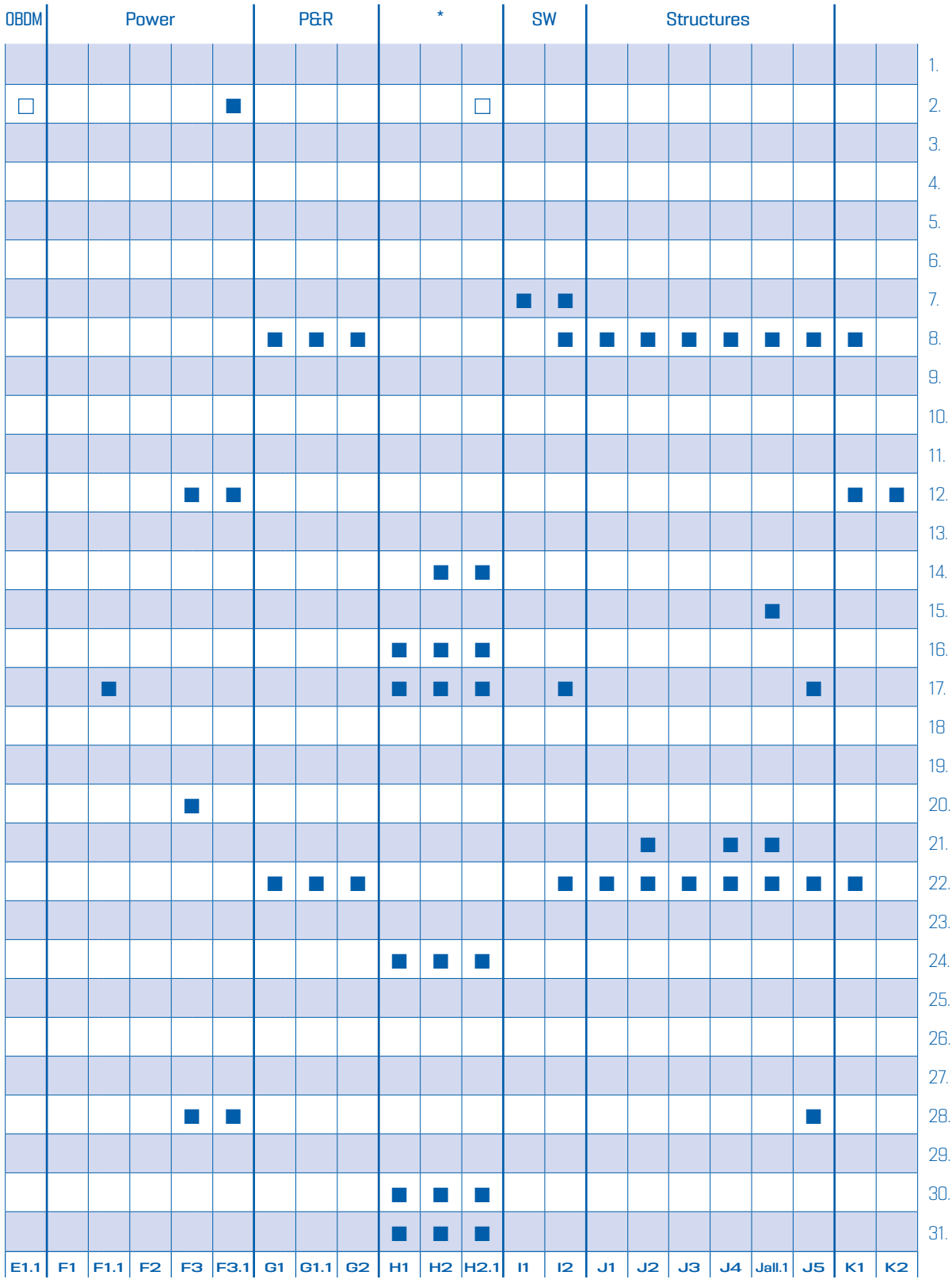
Thorium Space 30.
WiRan 31.
A1
A2
B1
B2
B3
C1
D1
D1.1
E1

Product tree
Ground Segment

Mission operations
A1 Control Centre general equipment
A2 Mission Control
A3 Operations Execution
A4 Other
Ground station
B1 Antennas
B2 RF equipment
B3 Baseband equipment
B4 Frequency & Time equipment
B5 Ground Station Monitoring & Control
Ground Segment Network
C Ground Segment Network (or Ground Comm. sub-net)
User Operations
D User Operations
Development and Construction of Space Segment
E1 Assembly Integration and Test
E2 General Support
Launcher specific Ground Segment
F Launcher specific Ground Segment

* Development and Construction of Space Segment

		Mission operations				Ground station							*			
6ROADS	1.									■		■		■		1.
Airbus Polska	2.															2.
Astri Polska	3.									■	■		■	■		3.
Centrum Badań Kosmicznych PAN	4.		■	■						■		■	■	■		4.
Creotech Instruments	5.		■	■								■	■	■		5.
Fundacja Technology Partners	6.															6.
GMV Innovating Solutions	7.		■	■						■		■				7.
Hertz Systems Ltd	8.	■	■	■						■	■		■			8.
ICEYE Polska	9.	■	■	■	■					■	■	■	■	■		9.
InPhoTech	10.															10.
Jakusz Space Tech	11.															11.
Komes	12.															12.
KP Labs	13.		■	■								■		■		13.
Microamp Solutions	14.						■									14.
PIAP Space	15.												■			15.
Polska Grupa Zbrojeniowa PGZ	16.					■	■			■	■					16.
QWED	17.					■	■	■					■			17.
Sat Revolution	18															18
Scanway	19.												■	■		19.
Semicon	20.															20.
SENER Polska	21.															21.
Sieć Badawcza ŁUKASIEWICZ -Instytut Lotnictwa	22.					■							■		■	22.
Sieć Badawcza ŁUKASIEWICZ -Przemysłowy Instytut Automatyki i Pomiarów PIAP	23.					■	■	■	■	■						23.
SpaceForest	24.					■	■									24.
Sybilla Technologies	25.				■					■		■				25.
SYDERAL Polska	26.															26.
ŚCNTPL	27.															27.
Tech Ocean	28.									■						28.
Thales Alenia Space Polska	29.															29.
Thorium Space	30.					■										30.
WiRan	31.					■	■						■			31.
		A1	A2	A3	A4	B1	B2	B3	B4	B5	C	D	E1	E2	F	


OBDM
Power
P&R
*
SW
Structures
E1.1
F1
F1.1
F2
F3
F3.1
G1
G1.1
G2
H1
H2
H2.1
I1
I2
J1
J2
J3
J4
Jall.1
J5
K1
K2

Thermal control

	K3	K4	Kall.1	K5	
1.					1.
2.					2.
3.					3.
4.					4.
5.					5.
6.					6.
7.					7.
8.				■	8.
9.					9.
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11.					11.
12.	■	■	■	■	12.
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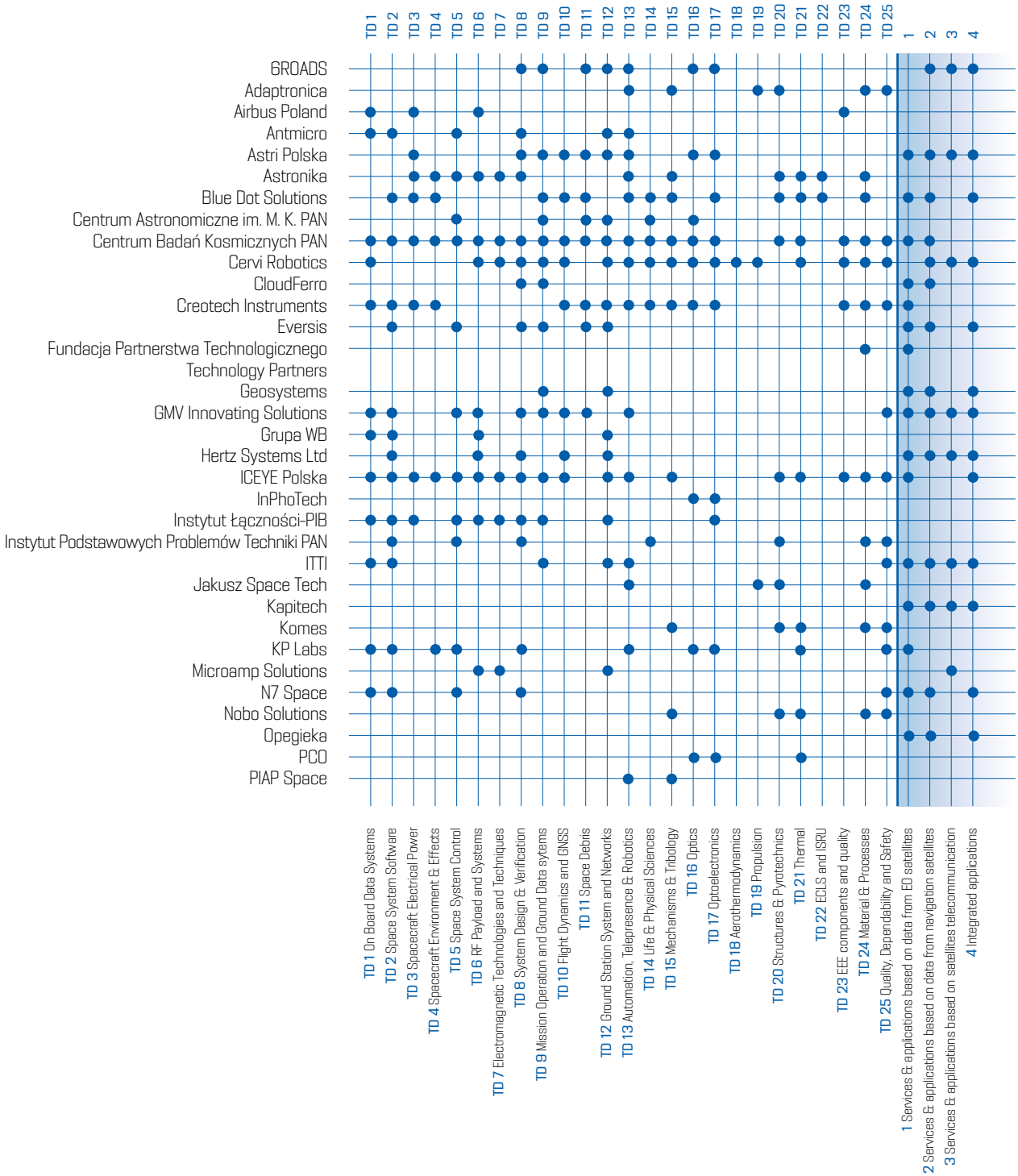
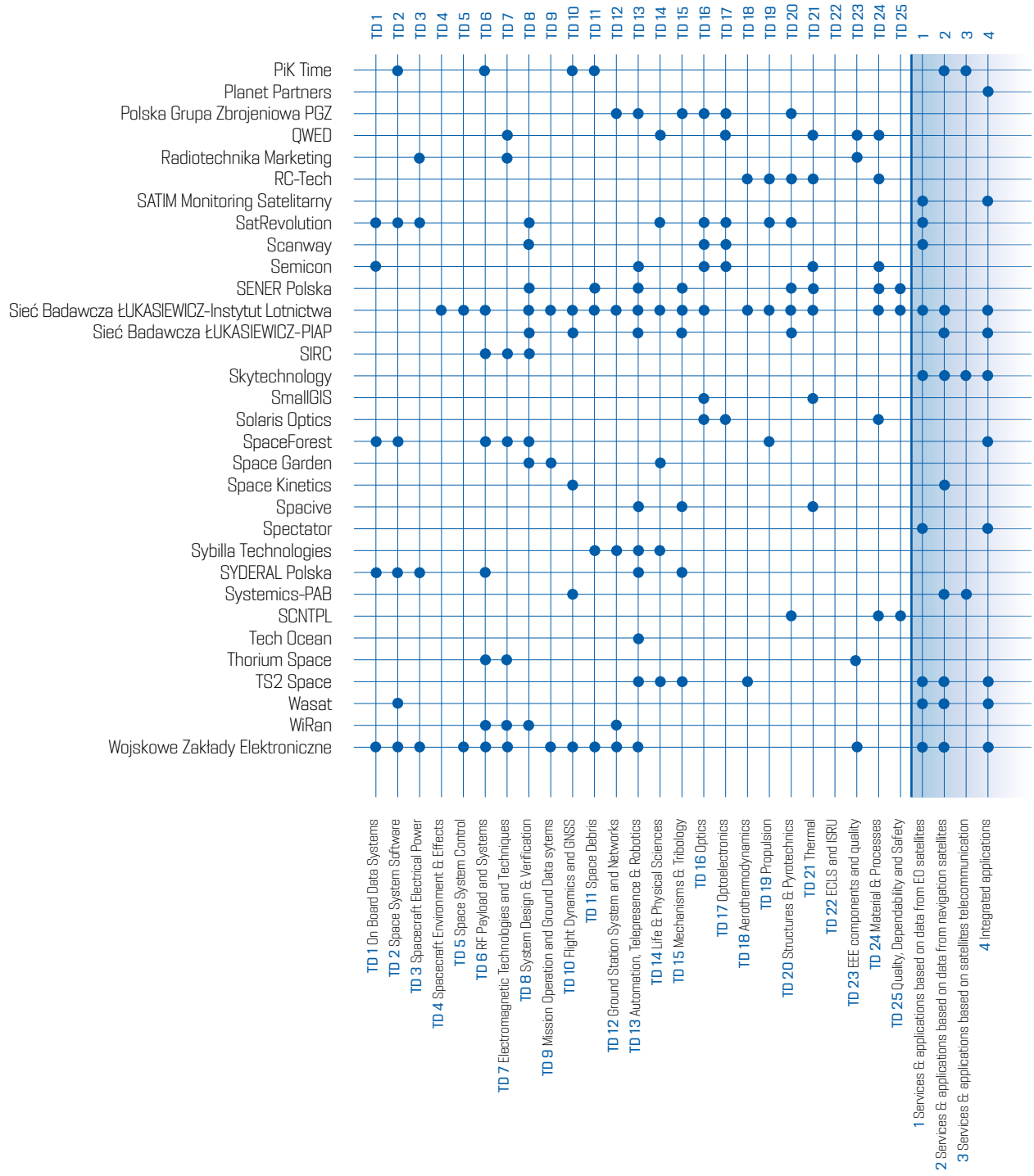
30.					30.
31.					31.

Technology tree




TD 1
TD 2
TD 3
TD 4
TD 5
TD 6
TD 7
TD 8
TD 9
TD 10
TD 11
TD 12
TD 13
TD 14
TD 15
TD 16
TD 17
TD 18
TD 19
TD 20
TD 21
TD 22
TD 23
TD 24
TD 25
1
2
3
4
PiK Time
Planet Partners
Polska Grupa Zbrojeniowa PGZ
QWED
Radiotechnika Marketing
RC-Tech
SATIM Monitoring Satelitarny
SatRevolution
Scanway
Semicon
SENER Polska
Sieć Badawcza ŁUKASIEWICZ-Instytut Lotnictwa
Sieć Badawcza ŁUKASIEWICZ-PIAP
SIRC
Skytechnology
SmallGIS
Solaris Optics
SpaceForest
Space Garden
Space Kinetics
Spacive
Spectator
Sybilla Technologies
SYDERAL Polska
Systemics-PAB
SCNTPL
Tech Ocean
Thorium Space
TS2 Space
Wasat
WiRan
Wojskowe Zakłady Elektroniczne
TD 1 On Board Data Systems
TD 2 Space System Software
TD 3 Spacecraft Electrical Power
TD 4 Spacecraft Environment & Effects
TD 5 Space System Control
TD 6 RF Payload and Systems
TD 7 Electromagnetic Technologies and Techniques
TD 8 System Design & Verification
TD 9 Mission Operation and Ground Data sytems
TD 10 Flight Dynamics and GNSS
TD 11 Space Debris
TD 12 Ground Station System and Networks
TD 13 Automation, Telepresence & Robotics
TD 14 Life & Physical Sciences
TD 15 Mechanisms & Tribology
TD 16 Optics
TD 17 Optoelectronics
TD 18 Aerothermodynamics
TD 19 Propulsion
TD 20 Structures & Pyrotechnics
TD 21 Thermal
TD 22 ECLS and ISRU
TD 23 EEE components and quality
TD 24 Material & Processes
TD 25 Quality, Dependability and Safety
1 Services & applications based on data from EO satellites
2 Services & applications based on data from navigation satellites
3 Services & applications based on satellites telecommunication
4 Integrated applications

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