



CENTER OF SPACE TECHNOLOGIES

REMOTE SENSING DIVISION

Acquisition of aerial images

We acquire images using different types of cameras, in particular, using designed and built at the Institute of Aviation multispectral platform Quercus, which records electromagnetic radiation in six narrow spectral bands ranging from 450 to 1000 nm.

Processing of aerial images

Acquired aerial images are processed using Professional Photogrammetric Station. For example, orthophotomaps, high-rise layers (DTM and DSM) and vector maps can be delivered.

Spectral analysis

We provide advanced spectral analysis based on acquired aerial images and laboratory measurements (using our Spectral Signature Testbed). We can determine such indicators like: NDVI, NDWI, NDII, MSI, LAI, etc., used for estimating healthiness of organic matter, water and pollution content, etc.

Radio communication

We create radio coverage maps for simple mobile systems using numerical land cover models and parameters of a desired communication system. Analytical workson optimizing parameters of simple mobile communication systems are also carried out.

Multispectral camera

The multisensory platform Quercus built in the HESOFF project allows imaging in different ranges of electromagnetic radiation.

Stereometric analysis

We carry out research on three-dimensional models based on satellite and aerial images, especially using topological tools (Irving Fisher theorem, Banach fixed point). Our algorithms are used in modeling small parts of the Mars surface (Terra Sirenum, Athabasca Valles). In addition, we offer creating precise models of objects based on aerial images (models of individual objects and entire urban structures).

Precision measurements

We carryout precise measurements using RTK GPS receiver. By employing corrections of the ASG EUPOS network we can obtain coordinates of individual points with a centimeter accuracy. Using GPS receiver we carry out ground control points measurement. We can also deliver a vector map of a selected area.

We havehigh accuracy GPS / IMU system that allows measuring the rapidly changing parameters of a mobile platform, e.g. tilt camera angles during the photo mission.

Thermography

We carry out thermal imaging measurements, i.e. recording and processing images in the mid and far infrared. We use thermal camera FLIR SC600 with a resolution of 640x480 px and the viewing angle of 25 degrees. We carry out various non-standard thermal imaging projects, and develop own algorithms for analyzing acquired images.

AIRCRAFT PROPULSION DEPARTMENT

The Aircraft Propulsion Department carries out research in the following areas and by the following laboratories:

- research of piston and turboshaft engines,
- Laboratory of Combustion Chambers,
- measurements of aircraft noise (in accordance with FAR 36 and ICAO16),
- research works on flows,
- static/dynamic balancing,
- testing of panes puncture-proof,
- safety testing for general Aviation.

The scope of activities carried out at the Department comprises structural and computational works using 3D software (SolidWorks and Fluent) as well.

RESEARCH OF PISTON AND TURBOSHAFT ENGINES

Laboratory carries out research and measurements of:

- basic engine parameters (temperature, speed, fuel consumption) according to national and international standards,
- smoke according to ECE R24 Regulations.

LABORATORY OF COMBUSTION CHAMBERS

Research is carried out on deflagration and detonation combustion in combustion chambers of turbine engines. The air delivery system can supply the test bed with air flow up to 2 kg/s of pressure of 6 bars and a temperature to 200°C combustion process is implemented for liquid and gaseous fuels.

MISSION

The Center of Space Technologies is one of the latest investment carried out at the Institute of Aviation. CST was founded in 2013. The Center has been created in order to conduct research in the areas of: air propulsion, space technologies, data processing and avionics. The Center currently consists of four divisions: Space Technologies Division, Aircraft Propulsion Department, Remote Sensing Division, Avionics Division. In the center acting laboratories certified by PCA: Piston Engine Laboratory (Certificate No. AB 130) and Environmental Laboratory (Certificate No. AB 132).

The Center of Space Technologies, thanks to its laboratory and personnel backup is able to offer a wide range of technology development in areas such as rocket engine systems, observing the earth's surface, analysis and processing of aquired images or new materials. CST's mission is to conduct research in the field of space technology for the needs of their implementation by the national and international traders.

DEVELOPMENT PLAN OF THE CENTER

Among the plans of the Center are increasing participate in the construction of hydrazine-free satellite propulsion, including stabilizing systems, product development integrating the use of navigation, observation and satellite communications. Another priorities of the Center are to build the space ground segment for access to satellite communications. Also in the context of the Space Situational Awareness, Program the Center of Space Technologies has a its goal the gaining access to the results of observation, whereas in the field of aerial and satellite imagery - to develop products as acceptable sources of information for security, crisis management and environmental monitoring.



AB 130



AB 132



AVIONICS DIVISION

The Division carries out scientific and research works and design and engineering works, as well as small series production of avionics systems and devices, measurement and diagnostics devices, and electrical installations and systems for planes, helicopters and unmanned aerial vehicles. The Division is also equipped with a certified Laboratory for Environmental Research. The Division takes part in Polish and European grants (ERA, EPATS, SOFIA, Super SKYSENSE, CESAR).

The Division is approved as a Production Organization and a Maintenance Organization. The Production Organization of the Aviation Institute, approved by the Civil Aviation Authority (Urząd Lotnictwa Cywilnego) by Regulation 216/2008 of the European Parliament and by the European Council and European Commission Regulation 1702/2003 under Part 21, Section A, Subpart G, is authorized for production of the products, parts and appliances listed in its approval list, and for issuing an approved production organization authorized release certificate EASA FORM I form.

The Division offers design and construction works as follows:

- systems involved in airplane and RPAS movement in civil airspace, in all flight stages,
- avionics systems, especially stabilization and classical, indirect and automatic steering of airplanes, RPAS, satellites and other steering systems,
- avionics devices for movement measurement (a.o.: CDA, radio-altimeter), spatial position (a.o.: INS, AHRS) and operational values (a.o.: fuel meters),
- mathematical modelling of aircraft flight dynamics,

- design of microprocessor systems as conversion devices dedicated for measurement systems and devices, stabilization, control and diagnostics systems, especially for airplanes, RPAS, satellites avionics equipment, and also for other devices and system elements that demand the use of a computing platform for implementation of numerical algorithms,
- fast prototyping of avionics devices, their assembly and certified production for the commercial user,
- testing the resilience and strength regarding mechanical conditions (vibrations and hits) and climatic conditions (ambient temperature, increased moisture, low pressure) of technical devices and installations, aerostructures and avionics, and also other devices and system elements designed in the Institute of Aviation, which demand such testing.

The Division is capable to conduct and supervise technical investigations and tests of systems and aircraft equipment and is entitled to issue statements of compliance with RTCA, ARINC, MIL and TSO standards and aircraft requirements.

The Division has the potential to manufacture prototypes and carry out short-run production of smart systems aimed at precise measurement, diagnostic and indicating tasks.

ENVIRONMENTAL LABORATORY

The Laboratory acquired Testing Laboratory Certificate No. AB 132, issued by the Polish Center for Accreditation in February 2005, in compliance with PN-EN ISO/IEC 17025:2005 standard requirements. The scope of this certificate covers tests of resistance to mechanical hazards, climate stresses and functional inspection of products.

Capabilities:

- strength and resistance to sinusoidal vibrations for objects of a mass up to 400 kg, with a frequency range of 5 - 2500 Hz, acceleration amplitude up to 900 m/s², displacement amplitude up to 25 mm,
- broad band vibrations for objects of a mass up to 400 kg, with a frequency range of 5 - 2000 Hz, acceleration amplitude 0.3 - 240 m/s², spectral density from 0,004 to 45 (m/s²)² × Hz⁻¹,
- strength and resistance to repeated mechanical shocks for objects of a mass up to 400 kg, acceleration up to 3200 m/s², frequency up to 3 Hz, and on impulse duration range of 1 - 30 ms,
- resistance to high and low temperatures, in a temperature range of -80°C to +180°C,
- resistance to cyclic temperature changes within the range from -80°C to +180°C,
- resistance to a high level of humidity within the range from 20% to 98%,
- resistance to low pressure from atmospheric pressure to 60 hPa,
- frost and moisture resistance.

SPACE TECHNOLOGIES DIVISION

Space Technologies Division is one of the few Polish research centers which carry out development works for new rocket technologies for civil applications. High qualified specialists in different fields of knowledge, employed in the Division, are specialized in the designing and testing of rocket engines and launchers using environmental friendly fuels. All the research works are performed with use of CATIA and ANSYS FLUENT professional software.

The scientific and research works in terms of space technologies cover:

- design and testing of hybrid rocket engines,
- design and testing of liquid rocket engines,
- design and testing of solid rocket engines,
- development of environmental friendly fuels technologies,
- production and testing of grains for solid rocket fuel,
- design and testing of launcher technology demonstrators,
- CFD i FEM dedicated software,
- multistage rocket flight dynamic analysis,
- internal ballistics of solid rocket engines analysis,
- optimization of liquid rocket engines combustion chambers.

At present the Division consists of three laboratories:

- Laboratory of Propellants,
- Laboratory of Catalysts,
- Laboratory of Space Propulsion.

LABORATORY OF PROPELLANTS

The offer of the Laboratory of Propellants:

- preparation of hydrogen peroxide of with a concentration of up to 99.99% for chemical analysis,
- preparation of hydrogen peroxide of HTP class (e.g. 98%+) for propulsion uses (rockets), ~2 liters/week,
- construction materials and hydrogen peroxide compatibility analysis,
- preparation of test samples of some energy materials, e.g. gas detonation initiation (primary explosives and some energy materials, e.g. PETN, RDX, HAN),
- testing of hypergolic fuels with hydrogen peroxide of HTP class,
- preparation of anhydrous red fuming nitric acid.

LABORATORY OF CATALYSTS

The offer of the Laboratory of Catalysts:

- preparation of catalysts for hydrogen peroxide on ceramic carriers, e.g. γ- and α-Al₂O₃,
- annealing of components in a ceramic furnace in a controlled temperature (up to 1100°C),
- drying in a vacuum oven in a controlled temperature (up to 250°C, vacuum 60 Pa, with working chamber dimensions of 415x345x370 mm),
- solvent recovery on a rotary evaporator, Buchi, 4L,
- determination of the dissolved solid content with the use of a spectrophotometer (biogenic compounds, contaminants, cations and anions contents).

LABORATORY OF SPACE PROPULSION

The offer of the Laboratory of Space Propulsion:

- development of applications for measurement and data recording using a LabView environment,
- design and testing of liquid, hybrid and solid rocket engines of thrust up to 5 kN,
- design of test stations for measurement of rocket engines' work parameters,
- design of launchers and analysis of their performance,
- preparation of CFD numerical codes for testing flows.