

POLISH CAPABILITIES IN SPACE ROBOTICS GENERAL OVERVIEW

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POLISH SPACE ECOSYSTEM

POLISH SPACE SECTOR

- CBK PAN – Space Research Centre PAS
- scientific institutes
- universities with high-tech specialisations



ADMINISTRATION

- national ministries and executive agencies
- committees and councils
- expert teams



INDUSTRY

- over 430 entities registered on ESA-EMITS
- approximately 70 members of the Polish Space Industry Association
- more than 330 contracts obtained by Polish entities for a total amount of over €100 million



SCIENCE



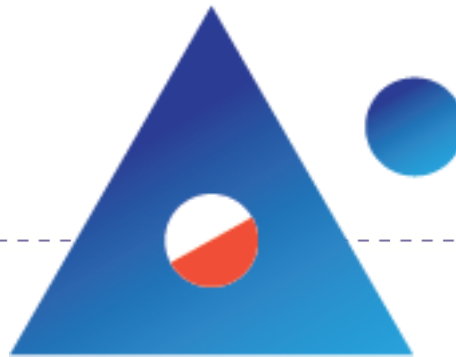
SECURITY AND DEFENCE

AREAS OF EXCELLENCE

Robotics is one of the leading space domains of the European Space Agency.

This domain was identified by the Polish Space Industry Association as one of the four main objectives for development in the Polish space sector. The association represents about 80% of all entities involved in the space sector.

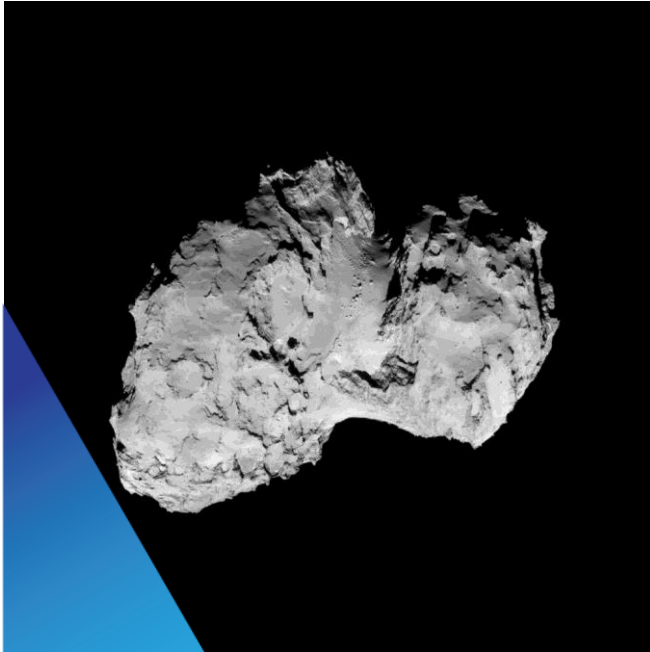
Polish competencies are built on several small and medium sized enterprises. They are accompanied by prestigious research institutes and technical universities like: CBK PAN, PIAP and academia in Łódź, Kraków, Poznań, Wrocław, Warszawa.



POLAND IN SPACE

EXAMPLES OF SPACE MISSIONS USING POLISH INSTRUMENTS AND DEVICES

MUPUS ON ROSETTA MISSION



67P/Churyumov-Gerasimenko.
Copyright: ESA/Rosetta/NAVCAM

MUPUS and its deployment – robotic system which demonstrates:

- probing thermal sensors into regolith
- measuring thermal properties of soil
- measuring mechanical properties of regolith



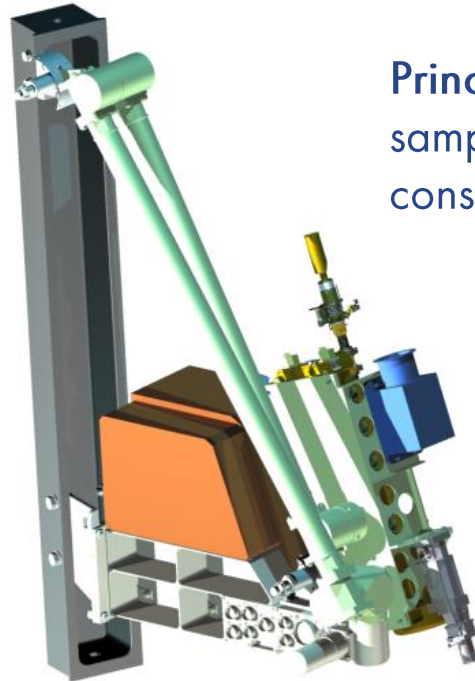
MUPUS
Copyright: CBK PAN

Main contractor in Poland: Space Research Centre PAS (CBK PAN)

POLAND IN SPACE

EXAMPLES OF SPACE MISSIONS USING POLISH INSTRUMENTS AND DEVICES

CHOMIK ON PHOBOS-GRUNT MISSION



Principal task:
sampling
consolidated regolith



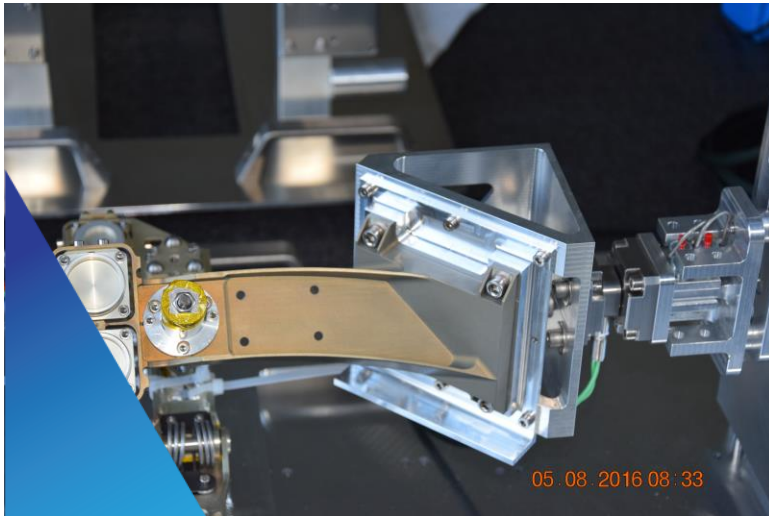
Geological Penetrator CHOMIK
Copyright: CBK PAN

Main contractor in Poland: Space Research Centre PAS (CBK PAN)

POLAND IN SPACE

EXAMPLES OF SPACE MISSIONS USING POLISH INSTRUMENTS AND DEVICES

POLISH MECHANISMS ON EXOMARS MISSION



Umbilical Release Mechanism
Copyright: SENER

Design, manufacturing, testing, and assembly of the Umbilical Release Mechanism connecting the rover with the transport vehicle and providing power supply during the process of robotic activation on the Mars Surface – SENER Sp. z o.o., PIAP

POLAND IN SPACE

EXAMPLES OF SPACE MISSIONS USING POLISH INSTRUMENTS AND DEVICES

HP3 PENETRATOR ON INSIGHT MISSION

Hammering Mechanism for HP3 Penetrator, an innovative project commissioned by the German Space Agency (DLR), developed for NASA's InSight Mars mission – Astronika Sp. z o.o.

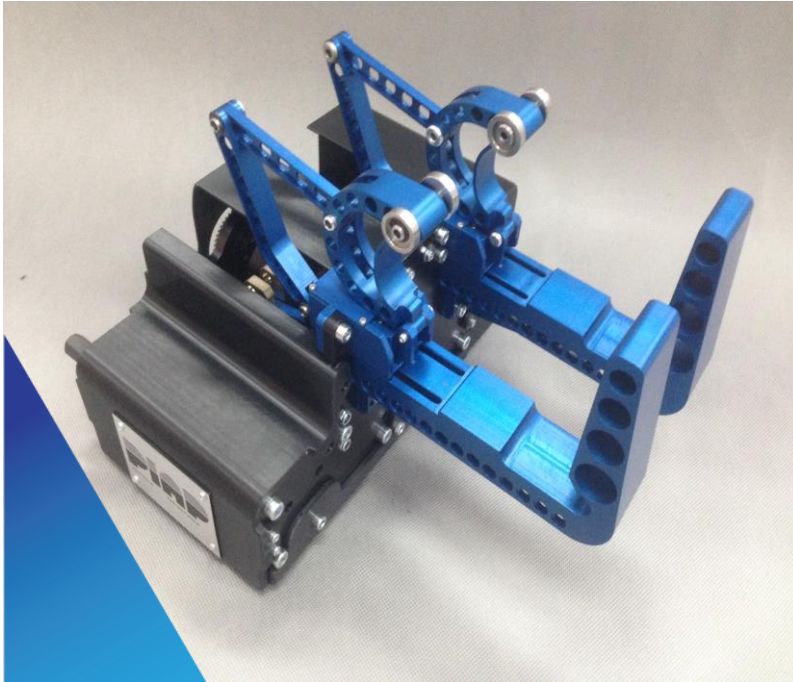


The HP3 mechanism model for the NASA InSight mission
Copyright: Astronika Sp. z o.o.

EXAMPLES OF OTHER POLISH

ACHIEVEMENTS IN SPACE ROBOTICS

EXAMPLES OF OTHER POLISH ACHIEVEMENTS IN SPACE ROBOTICS



ADReXp – an example of a robotic solution intended for future satellite servicing missions and deorbiting efforts

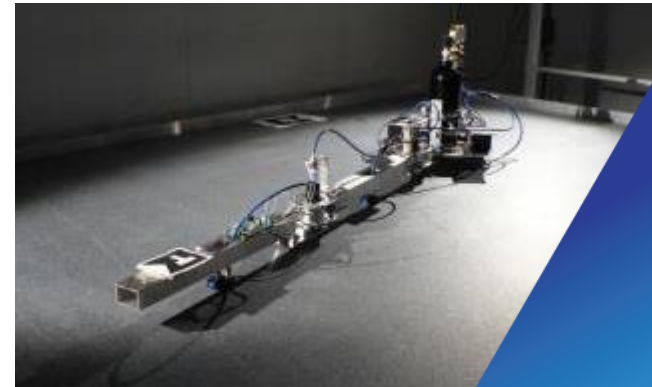
PIAP Space Sp. z o.o.

Copyright:
PIAP Space Sp. z o.o.

TESTING FACILITIES

RELATED TO SPACE ROBOTICS

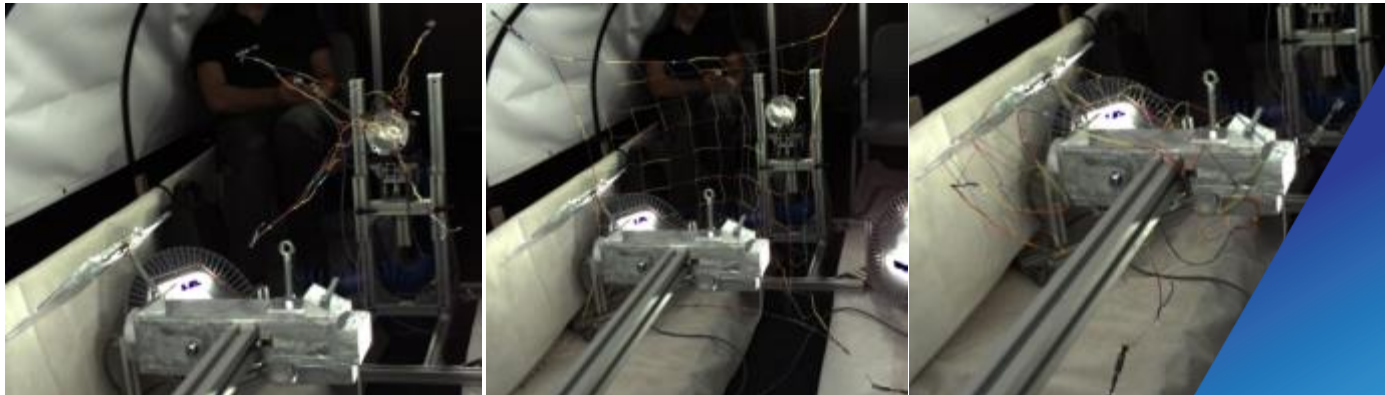
1. Test-bed systems development for on-orbit rendezvous maneuvers and debris removal (CBK PAN, PIAP).
2. Testing mechanisms – regolith interactions in special chambers (PIAP).
3. Ground-based infrastructure to track and monitor space debris (Poznan UT, CBK Borowiec).



TESTING FACILITIES

RELATED TO SPACE ROBOTICS

4. Testing subsurface locomotion (drills, moles) in different regolith analogues (CBK PAN).
5. Testing net operations in a near-zero gravity environment (SKA Polska).



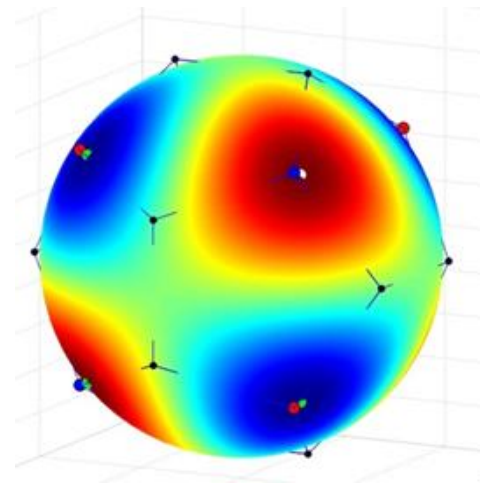
EXPERIENCE IN DISSEMINATION ACTIVITIES

RELATED TO SPACE TECHNOLOGY

1. Targeting university students – courses prepared based on EU projects related to space (AGH UT, Wroclaw UT, Poznan UT).
2. Targeting secondary school students – teacher training, classroom support (ESERO Poland).
3. Targeting technology dissemination (Astri Polska, CBK PAN, Universities).



DEPLiX



EXPERIENCE IN DISSEMINATION ACTIVITIES

RELATED TO SPACE TECHNOLOGY

4. European Rover Challenge --
an exciting opportunity to exchange ideas,
promote effective public relations and youth
involvement (ABM SE, Wrocław UT).



AREAS OF EXCELLENCE

1. **Subsurface exploration:** sampling devices, mechanisms for working in vacuum environments, testing facilities, subsurface navigation, control systems/control electronics, sensors, civil engineering, mining.
1. **Components for on-orbit robotic systems:** guidance, navigation and control systems (GNC), AOCS, hardware components (e.g., manipulator joints or links, nets), motion sensors, deployable structures.
1. **Dissemination activities:** focusing on young people in schools and universities, e. g. European Rover Challenge, lectures at universities.



EXAMPLARY ENTITIES FROM POLAND

INVOLVED IN AUTOMATION AND ROBOTICS

- Space Research Centre, Polish Academy of Sciences
- PIAP/PIAP Space
- SENER PL
- Astronika
- SKA-Polska
- ABM Space
- Robotics Inventions
- GMV PL



POLISH ENTITIES

INVOLVED IN AUTOMATION AND ROBOTICS

- **ABM Space** – robot construction and automation; software and robotic control systems; research of planetary analogs, with logistics and mission organization.
- **Astronika** – design, manufacturing, integration and testing of mechanical systems; geological penetrators; hold down & release mechanisms; antenna systems.
- **CBK PAN** – sampling mechanisms; penetrometers; electronics; subsystems; mechatronics; solar x-ray experiments; plasma experiments; space robotics; automatic sensors for regolith properties detection, including chemical, physical and mechanical data.
- **GMV Polska** – products, services and solutions in space pursuits; satellite navigation systems; autonomous GNC for Orbiting and Landing at Small Planetary Moons.

POLISH ENTITIES

INVOLVED IN AUTOMATION AND ROBOTICS

- **PIAP Space** – mobile robots for defense, security applications, mechatronic systems, automatization of production and montage lines, environmental studies and EMC, tests for functional components, subsystems and systems, automatic sensors for regolith properties detection including (chemical, physical and mechanical data).
- **SENER Polska** – design and integration of complete mechanisms, e. g., clamping mechanisms.
- **SKA Polska** – full range of engineering and research and development services in advanced multifunctional materials; modern, intelligent sensors; automation; control, signal acquisition and processing.
- **Robotics Inventions** – design and production of automatic and semi-automatic robots.

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