



REGIONE DEL VENETO



AGENDA
DIGITALE
DEL VENETO

SPAZIO ai NON SPAZIO

Tecnologie digitali dallo
Spazio alla Terra

2026

IN COLLABORAZIONE CON:



ARTIFICIAL INTELLIGENCE IN SPACE – ESA ACTIVITIES

Enhancing space missions through intelligent technologies

ESA COMMERCIALISATION GATEWAY

Spazio al non Spazio

Montebelluna, 24.02.2026

Michele Iapaolo

Innovation Services

Commercialisation Services Department

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AI in ESA Space Activities – Overview

1. AI in Mission Autonomy

AI used to enable spacecraft and systems autonomy and reduce reliance on ground control, enabling faster decision-making, critical for distant deep-space missions.

2. Upstream AI Applications

AI supports mission planning, ground-segment engineering and processing pipelines, satellite navigation and space systems health monitoring and anomaly detection in ESA operations.

3. Downstream AI in Data Analysis

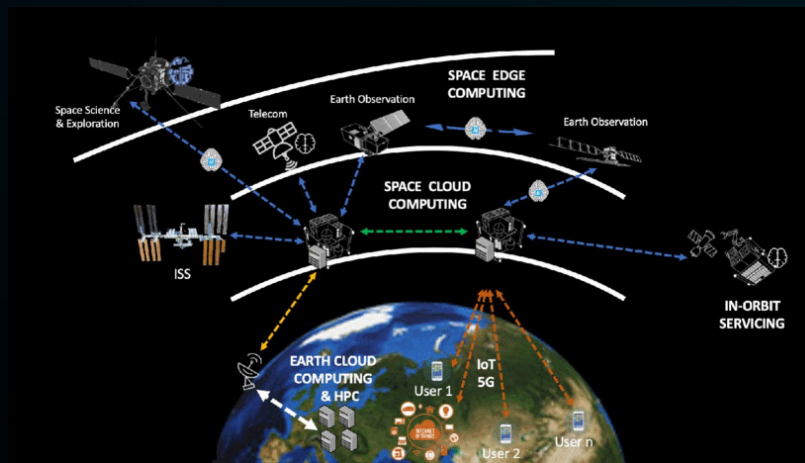
Machine learning and computer vision enable rapid Earth observation data fusion, change detection, trend analysis and object recognition.

4. AI Innovation Ecosystem

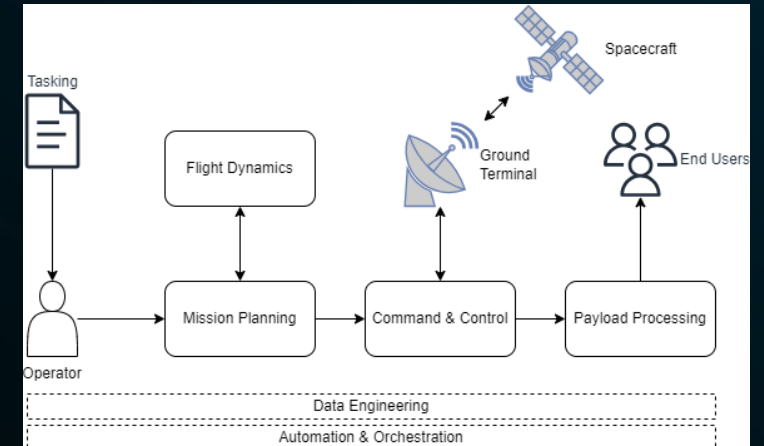
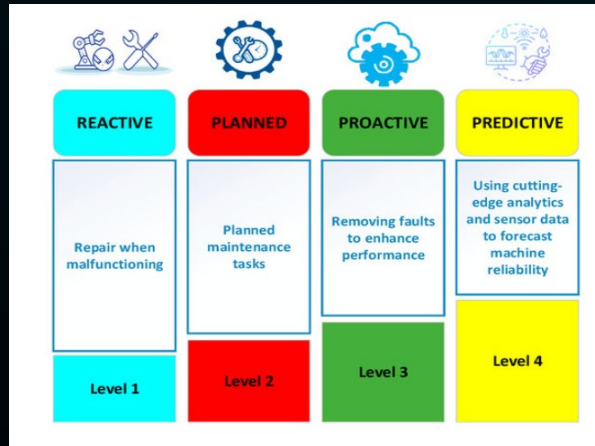
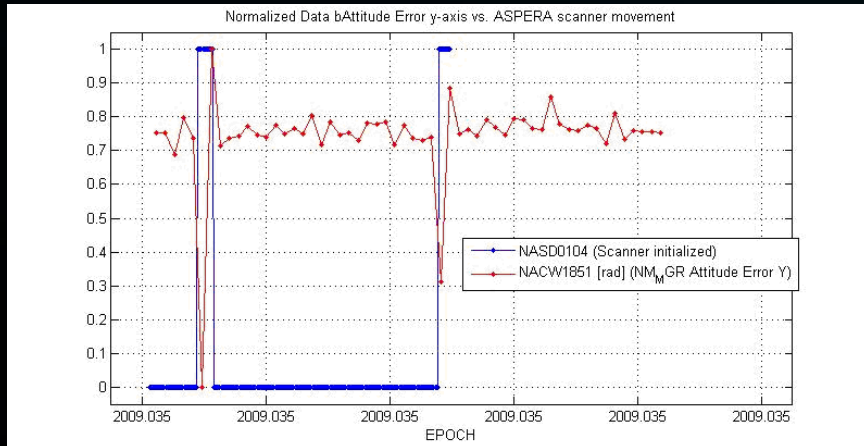
ESA promotes research and technology development on AI through dedicated initiatives, like the 's hubs like the Advanced Concepts Team (ACT) or the Φ-lab



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- A circular inset image showing the Mars rover Spirit on the Martian surface. The rover is a six-wheeled vehicle with a complex mechanical structure, including a camera mast and solar panels. It is positioned on the reddish-brown, rocky terrain of Mars. The background shows a hazy, orange-brown sky and distant, low-lying hills.

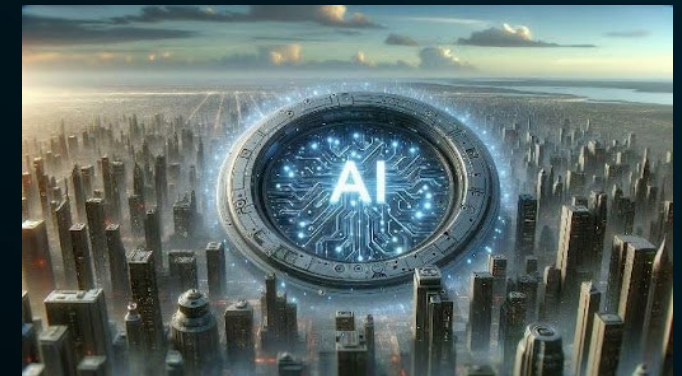
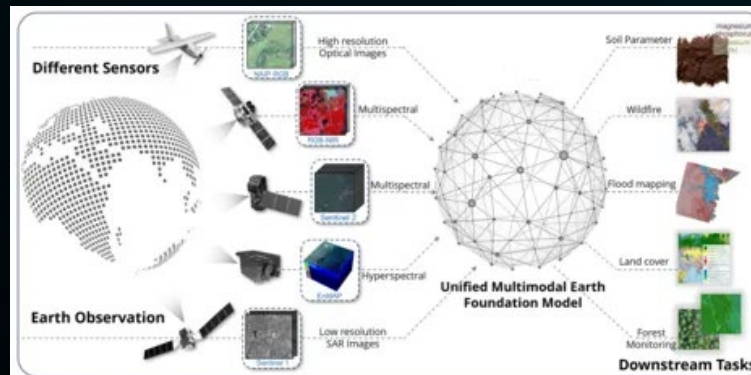
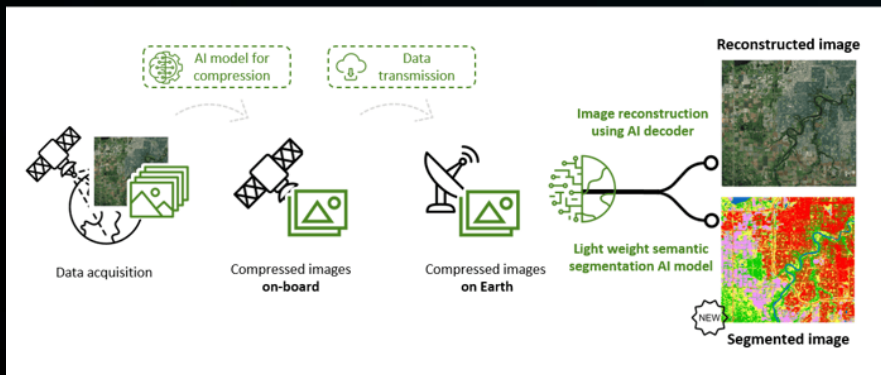


1. **Anomaly detection:** AI supports anomaly detection through data mining & machine learning models (e.g. DrMUST)
2. **Predictive maintenance:** Predictive maintenance tools forecast spacecraft subsystem degradation.
3. **Automated Health Monitoring:** flags deviations compared to expected spacecraft patterns.
4. **Decision support tools:** AI-driven planning tools provide support to operators in complex operations (planning, scheduling and mitigation measures).



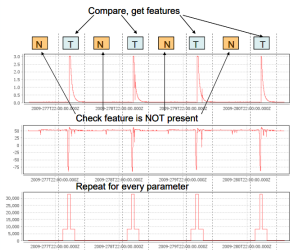
Downstream applications

1. **Earth Observation:** Machine Learning / Deep Learning (ML/DL) used to extract information from EO data (object detection, land-use classification, atmosphere monitoring, etc.)
2. **Data fusion & analytics:** AI improves multi-sensor data fusion enabling rapid environmental insights (exploiting different resolutions and spectral bands).
3. **AI-driven bandwidth reduction:** Onboard preprocessing reduces bandwidth needs for EO missions
4. **Navigation:** Generative AI for processing multi-source PNT data (incl. GNSS signals), inertial measurements, terrestrial beacons and crowdsourced information.



ESA key initiatives

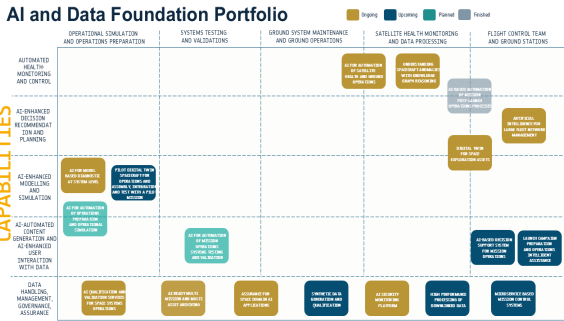
ORBIT-STAR
Anomaly and fault detection onboard the ISS
Columbus module



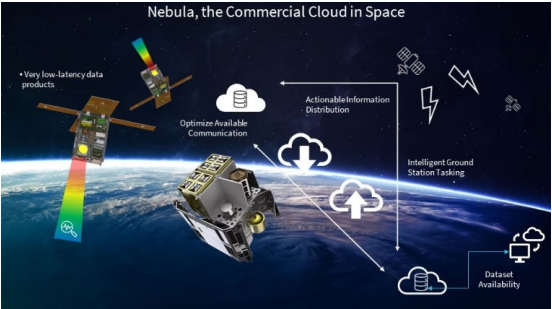
DrMUST
AI supported Pattern Recognition for spacecrafts anomalies

ESOC A2I Roadmap:

- Ainabler:**
Deployment of AI solutions
- OCAI:**
Operations Companion
- 4caster:**
AI forecasting application
- Root cause anomaly assistant:**
LLM to support investigations
- Anomaly Dataset:**
Large-scale, real-life satellite telemetry dataset with curated anomaly annotations



Cognitive Cloud Computing in Space



Advanced Concepts Team (ACT) – Open Space Innovation Platform (OSIP)
Explores cutting-edge AI techniques for space applications
(reinforcement learning, generative modelling, neuromorphic computing, etc.).

Transforming and innovating Earth Observation



- Artificial Intelligence and Machine Learning
- Quantum and Edge Computing
- IoT, Blockchain and Cognitive cloud Computing



Digital Twins designed to replicate and simulate the behaviour of Earth's systems

AI for Navigation Systems



ACCESS Programme – Element 1 – ScaleUp



Phi-LabNET

10 Phi-Labs

Thematic approach

Bridging the gap between groundbreaking R&D and Commercialisation



BUSINESS INCUBATION CENTRE

Business Incubation

36 Centres in over 100 locations

230+ new startups per year

2000+ startups supported since 2004



Technology Brokers

12 Technology Brokers

450+ technology transfers created

Supporting both spin-off and spin-in activities



Business Accelerators

First ESA Business Accelerator launched in Germany

Providing the knowhow and expertise of converting startups into scaleups

[TRL7-9]



Marketplace

Building your commercial pipeline

Creating competitiveness on the global market

[TRL7-9]



Patents

119 inventions protected by 529 granted patents or patent applications

Protect the intellectual property of ESA inventors

Providing patent searches and prior art services

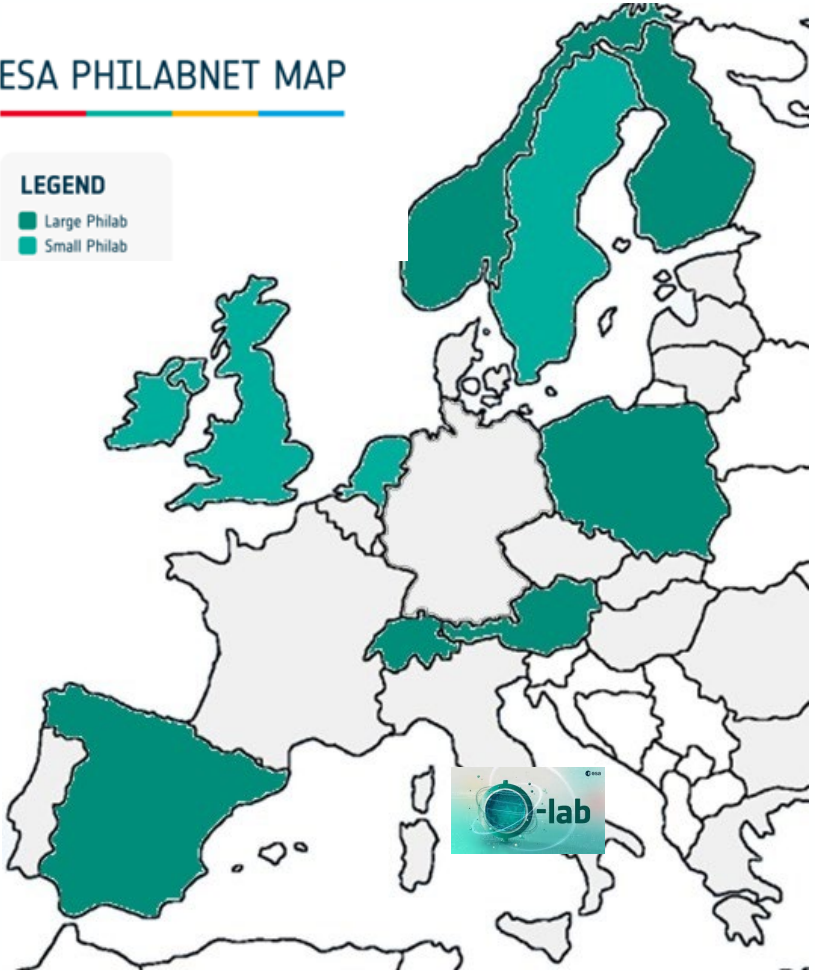
ESA Phi-LabNET – implementation 2023-2025

- Austria**
Industrial innovation for the upstream domain
(TEC-MSP)
- Switzerland**
Deep tech innovation (quantum, data, materials)
(TEC-R)
- Poland**
Robotic and AI for autonomy
(TEC-SFA) (TEC-MMA)
- Ireland**
Next generation space-optimised hardware
(TEC-MS) (TEC-MSP)
- Norway**
Arctic requirements and needs
- Spain**
Space technologies and their application to boost climate resilience
- Netherlands**
EO, critical PNT infrastructure, secure satellite communication
- Finland**
Sensors & Geospatial Innovation
- UK**
Space enabled sustainability technologies

ESA PHILABNET MAP

LEGEND

- Large Philab
- Small Philab



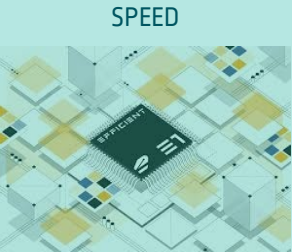
Phi-Lab Sweden

AI and Edge Learning

Empowering AI and Edge solutions for Space

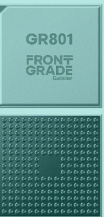


Edge-AI capabilities for Earth Observation (EO) satellites to enable faster and more efficient data utilization.



Energy-efficient onboard processing architectures

VAIAS



Validation of a neuromorphic AI Accelerator in Space

1. Startups where AI is the core product / technology
2. Startups using AI for Environmental / EO Applications
3. Startups using AI for Drones, Robotics & Autonomous Systems
4. Startups using AI in Space-Technology / Onboard-AI / Autonomy
5. Startups using AI in Health / Diagnostics
6. Startups using AI for Logistics, Smart Cities, Safety



Startups and AI (some examples)

Actlabs



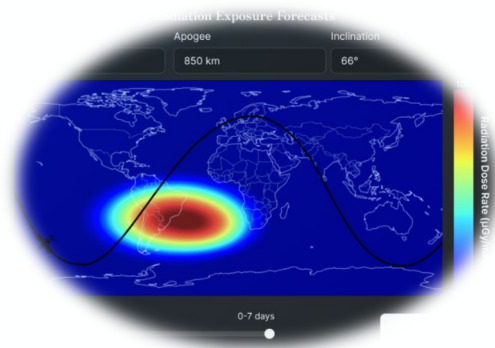
AI-powered microwave detection system for space debris (<10 cm)

autonomIQ



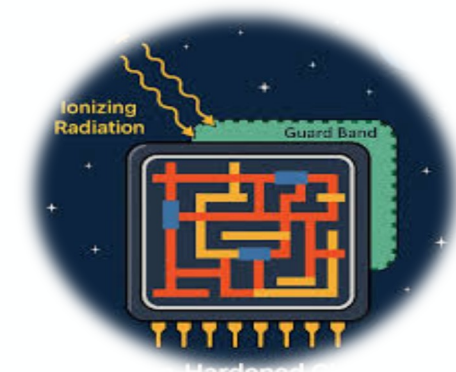
I-driven autonomous CAM planning for manufacturing and space components

Augura Space



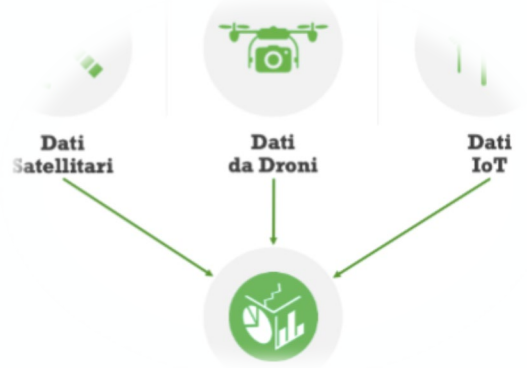
AI-driven GNSS space-weather disturbance prediction
historical analysis, real-time monitoring, and predictive forecasts

Magics Instruments



Machine-learning-based smart sensors for radiation-intense environments
(radiation-hardened ICs for space and nuclear applications.

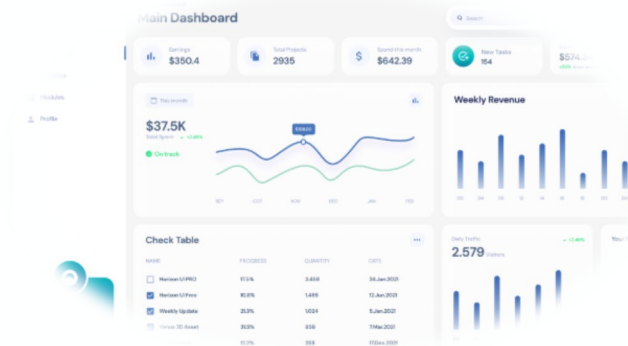
Startups and AI (some examples)



ML and DM for agricultural decision-support systems

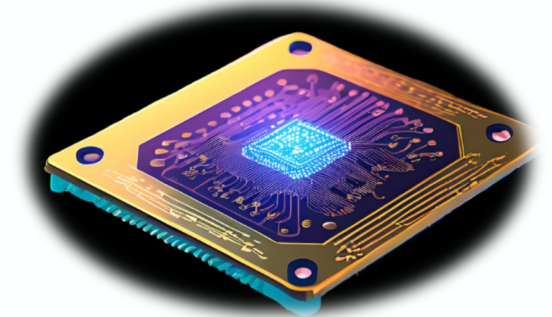


AI Agents for autonomous Space Navigation / GNC



Generative models and time-series analysis for multispectral image forecasting

DAIDALOS



AI accelerators that improve performance and reduce energy

A2I Roadmap @ ESA's Missions Operations



<https://esoc.esa.int/a2i-roadmap-esas-missions-operations>

Enabling Artificial Intelligence for Space System Applications (Technology Harmonisation Dossier)

<https://technology.esa.int/page/harmonisation>



ESA COMMERCIALISATION GATEWAY

Thank You!!

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