

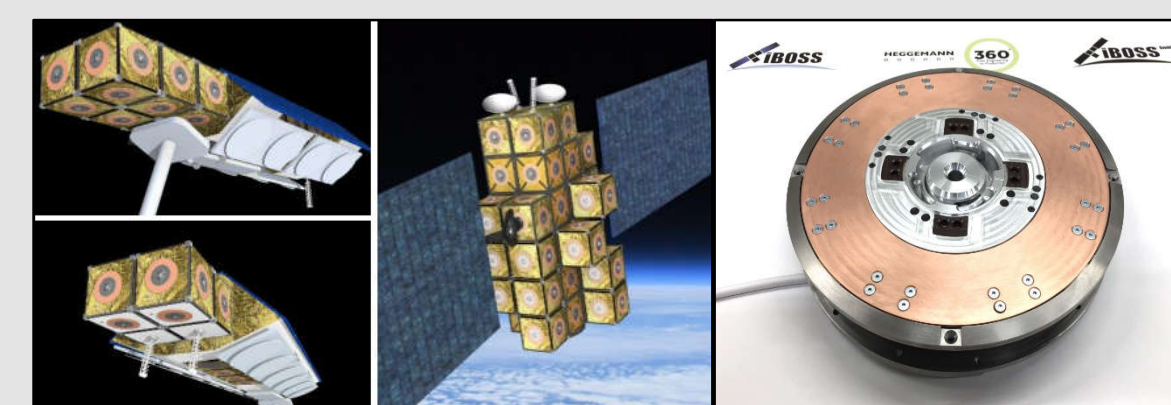
German space robotic roadmap.

The Roadmap

The Space Administration of the German Aerospace Centre (DLR) has formulated a roadmap to integrate and focus the German activities in space robotics, in order to enable the German industry and research environment to participate in international endeavors and develop commercial services. The roadmap is implemented through two funding announcements, covering both the development of robotic system capabilities and spacecraft concepts. Some selected projects are presented here. As a member of the ESA and also EU, both of which invest substantial financial amounts in space technology research and development, the national activities are harmonized with these activities.

Concepts for modularization and standardization

The intelligent Building Blocks for On-Orbit Satellite Servicing and Assembly (iBOSS) has been supported many years as a new approach for a sustainable way of building, installing and maintaining orbital structures. Satellites are composed of functional blocks interconnected by a standardized interface, the intelligent Space System Interface (iSSI). The modular approach allows for robotic servicing, reconfiguration and assembly in orbit.



iBOSS concept (left hand side) and the interface iSSI (right hand side).

The iBOSS project has reached TRL 5 and parts are currently being further developed in the project "SLOT4.0" as a standard hosted payload module for small satellites to allow a very late integration.

Another approach investigated together with the industry in the project "Nucleus" envisaged a less radical approach, where several subsystems, such as power units and gyros, are available at various scales or qualities for attachment around a nucleus, serving as the core of the standard satellite platform.

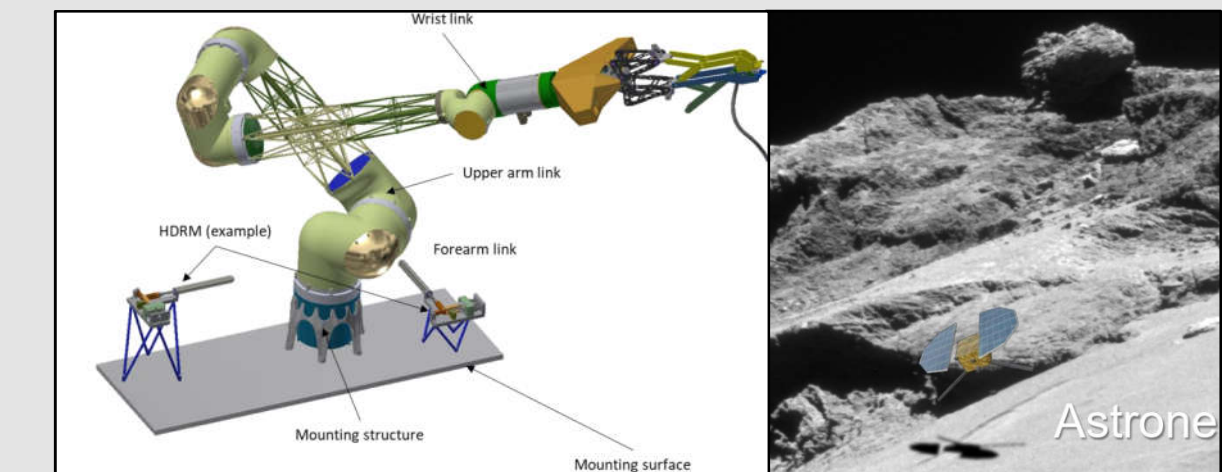
Robotic systems

In the project Flexible Orbital Manipulator (FOM) the aim is to demonstrate a multi-axis manipulator with an adaptable and flexible tool for applications in LEO and GEO. The layout and assembly of a technology demonstrator are developed to increase the readiness level to TRL4 in early 2022.

In "Astrone" an agile autonomous science platform with extended surface mobility using electric propulsion is investigated and GNC-algorithms for trajectory planning and navigation in unknown terrains are developed, aiming to verify them in a PIL test in 2021.

Robotic technologies

In the project "intelliRisk", environmental awareness through efficient internal and external state monitoring is investigated as well as an AI-based assessment of the

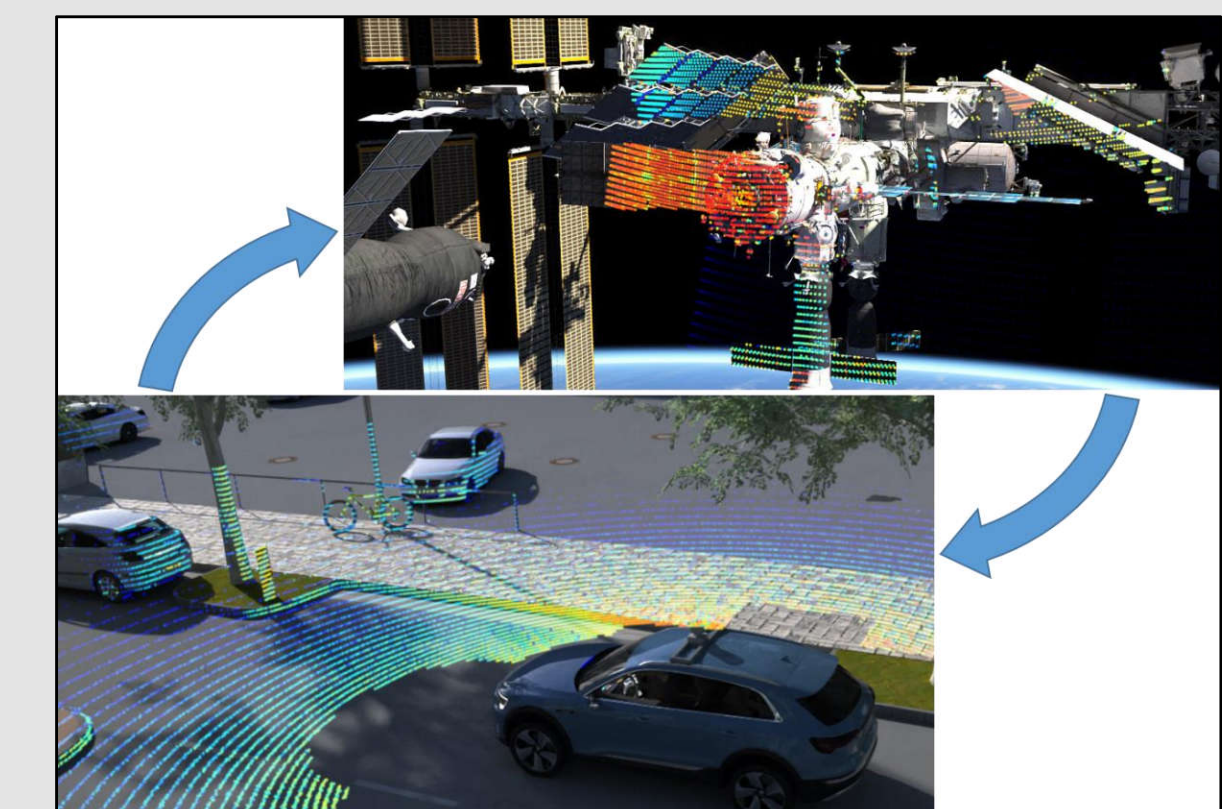


Flexible Orbital Manipulator (left hand side) and the Astrone concept (right hand side).

current internal status, external situation and evaluation of options for action. The decision making is based on an online risk assessment.

In "Mantos", a prototype development of AI-based intelligent robotic skills for capture and servicing operations is performed. A tool breadboard design and construction and also a definition of robotic operations and a robotic ground control console are evaluated in a combined hardware and virtual reality testbed

"ViTOS-II" is a project, where concepts, scenarios and processes for a smooth transition from simulated prototypes to real systems are developed and existing virtual testbeds for optical sensors in robotic applications are improved.



Simulation assisted methods and processes in the Virtual Testbed for optical sensors in robotic space systems (ViTOS-II).