

# Enabling Intelligent Robotic Manipulation In Space

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## Robotic Manipulation

- A **key technology** for sustainable space exploration and commercialisation.
- There is an urgent need for **Autonomous Robotic Systems** that perceive, reason and respond to dynamic changes.

**Challenges:** Harsh space conditions and computational constraints

**Gaps:** Data, test and validation, benchmark, sim2real

### Applications

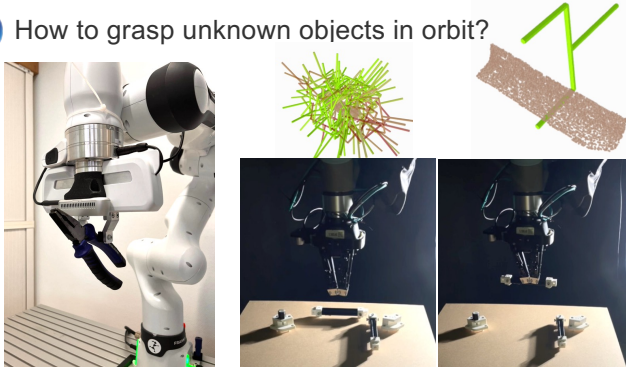
- In-Orbit Servicing
- Sample Collection
- In-Space Assembly and Manufacturing ISAM
- Outpost Construction



## Visual Intelligence

### Object-Centric 6-DoF Grasp Generation

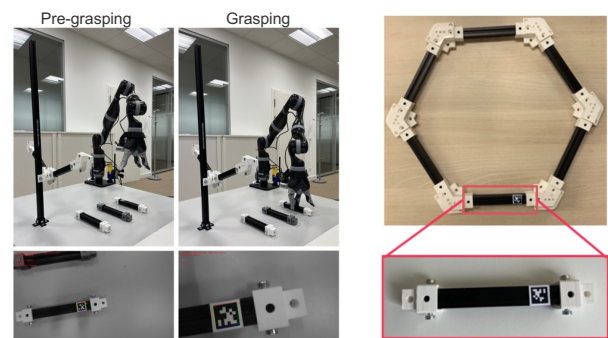
- How to grasp unknown objects in orbit?



• Industry Collaboration with **REDWIRE** Space Luxembourg

### Visual Servoing for ISAM

- How to precisely maneuver in space based on visual data?



## Simulations

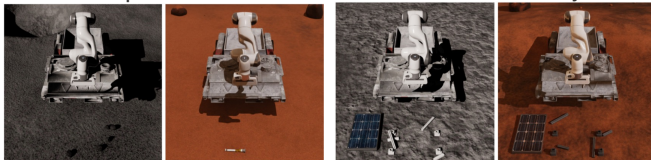
### The Space Robotics Bench

- Randomised simulations
- Parallelised simulations
- ROS 2 & Space ROS
- Planetary and Orbital scenarios
- Procedural Generation



Sample Collection

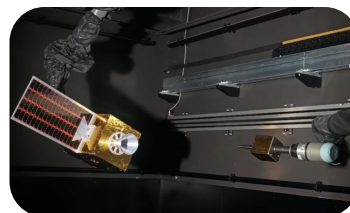
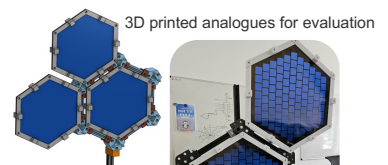
Solar Panel Assembly



## On-Ground Testing

### Benchmarking Skills

- Grasping
- Pick and place
- Two pin insertion
- Screwing / Unscrewing

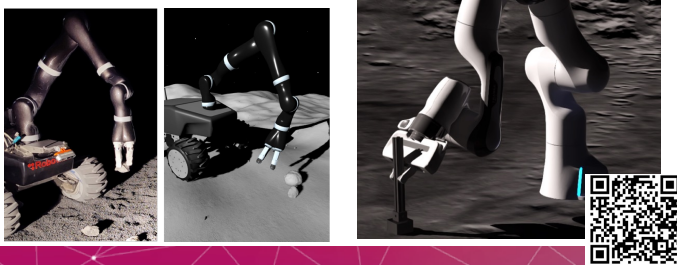


Emulation of In-Orbit Operations

## Reinforcement Learning

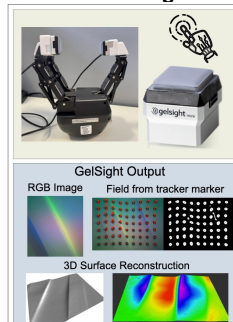
- Can robots in Space learn transferable skills?

- Learning a world-model
- Visual observations



## Other Technologies

### Tactile Sensing



### Compliant End-Effectors

