Development, Verification & Validation of AI-based GNC for space operations

From advanced simulation environments to a cutting-edge ground test facility

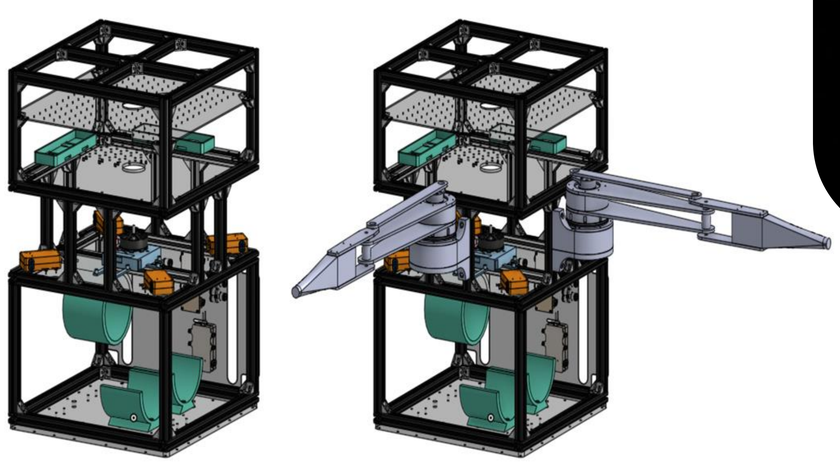
A. Arora, M. El-Hariry, R. Marsal I Castan, A. Orsula, G. Kremer, M. Reyaz, B. C. Yalcin, C. Martinez, M Olivares-Mendez

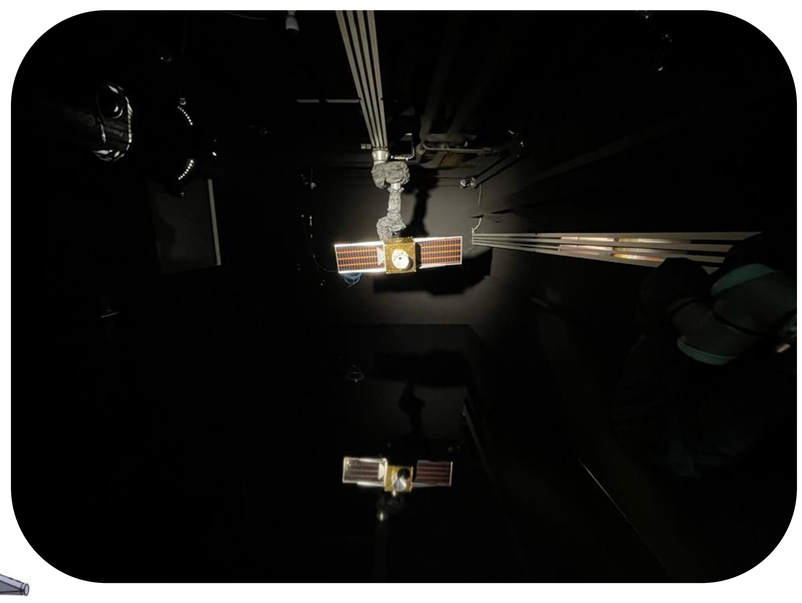
Space Robotics Research Group contact: miguel.olivaresmendez@uni.lu, carol.martinezluna@uni.lu

Zero-G Lab 2.0

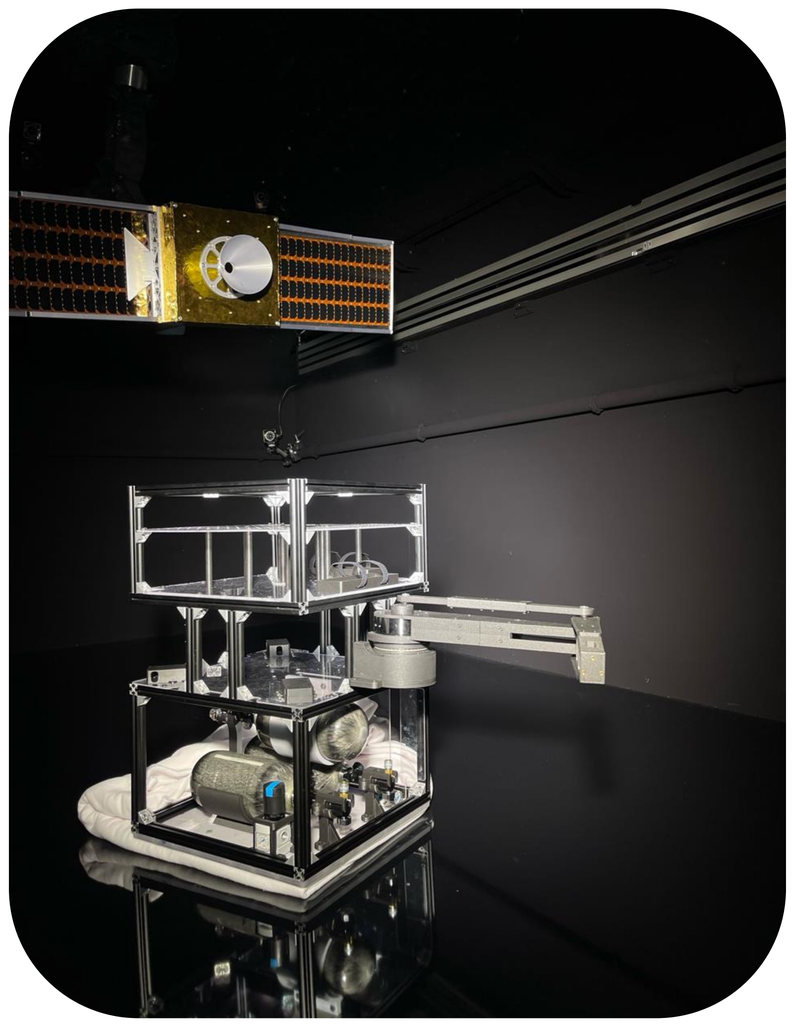
The **Zero-G Lab** is a cutting-edge facility designed to **simulate the microgravity conditions of space**. Recent upgrade:

- Optitrack cameras increased to 14 for evaluation accuracy.
- Metallic walls for emulating magnetic-based walking.
- Movable sun emulator.
- Walls with darkest black.
- New epoxy floor.
- 2 new Floating Platforms.





Robotic arms: complex interaction scenarios like satellite servicing or docking

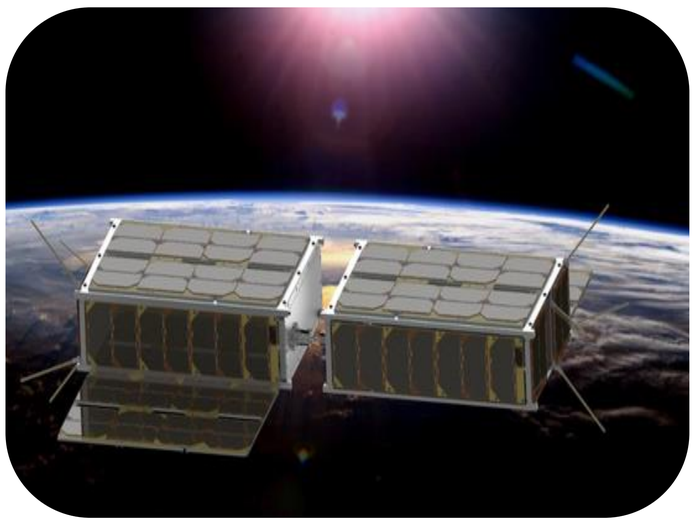


Floating robotic platform: near-frictionless motion for realistic autonomous orbital scenarios

ZeroG enables validation and development of **space operations** such as **rendezvous, docking, and in-orbit manipulation** — all within a highly controlled and immersive environment.

Ice2Thrust (EIC Pathfinder)

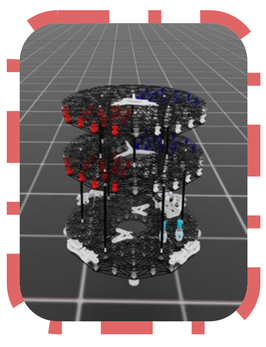
- Solar-powered, water electrolysis propulsion and autonomous docking to enable sustainable in-space mobility.
- RL algorithms for reliable proximity operations, docking and refuelling



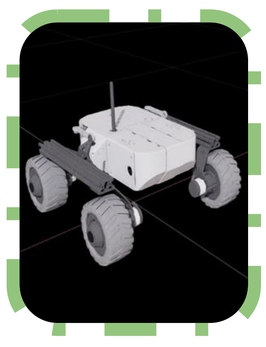
NavBench

- RL navigation policies on multiple robots in multiple mediums.
- Sim-2-Real transfer and evaluation.

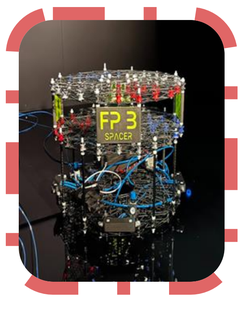
Boat



Floating Platform

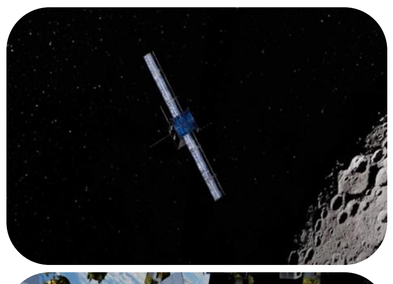


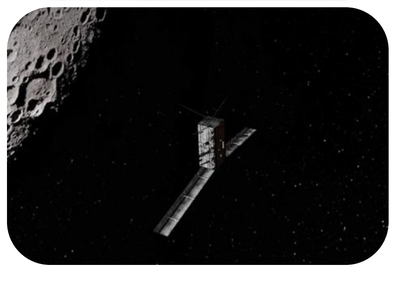
Lunar Rover



Space servicing & debris removal

- Simulations of autonomous space debris removal and space facilities inspection.





Supported by: Funded by the European Union | European Innovation Council | Funded by the European Union

In collaboration with: AIRSHIP | R3AMA | Ice2Thrust