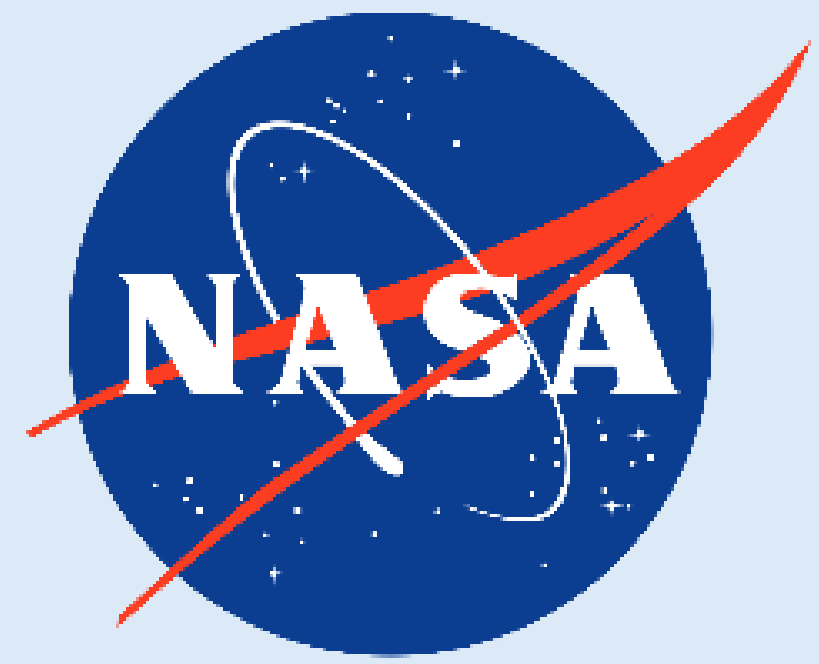


iMETRO



(Integrated Mobile Evaluation Testbed for Robotics Operations) Facility

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OBJECTIVE

Crew time in space is both precious and limited. Required routine tasks such as logistics, maintenance, and assembly consume valuable hours that could be spent on yielding scientific discoveries, and exploration milestones.

Remote robotics can offload these tasks. However, deploying mobile, dexterous robots in human-centered environments is still a **challenge**. Integration difficulties and unknowns are slowing adoption for flight missions.

iMETRO, a NASA JSC test facility, tackles the challenge. iMETRO uses representative robots to test, gather data, and contribute innovations to further the development of space robotic hardware—focused on logistics, maintenance, and science operations in pressurized (IVA) environments like habitats, rovers, and space station modules.

Our goal: Advance integrated robotic systems to higher **Technology Readiness Levels (TRL)** for real mission deployment.

WHAT iMETRO PROVIDES

Access to real robotic systems: The iMETRO facility provides both NASA internal and external partners access to multiple robots, robot simulations, and space use-case mockups, developed to represent current interfaces under development by NASA Moon to Mars exploration architecture.

Open-source ROS2 kinematic and dynamic simulations of the following:

- A dual-arm mobile manipulation robot
- A manipulator with a lift on a rail robot
- IVA-relevant mockups

Mockups available:

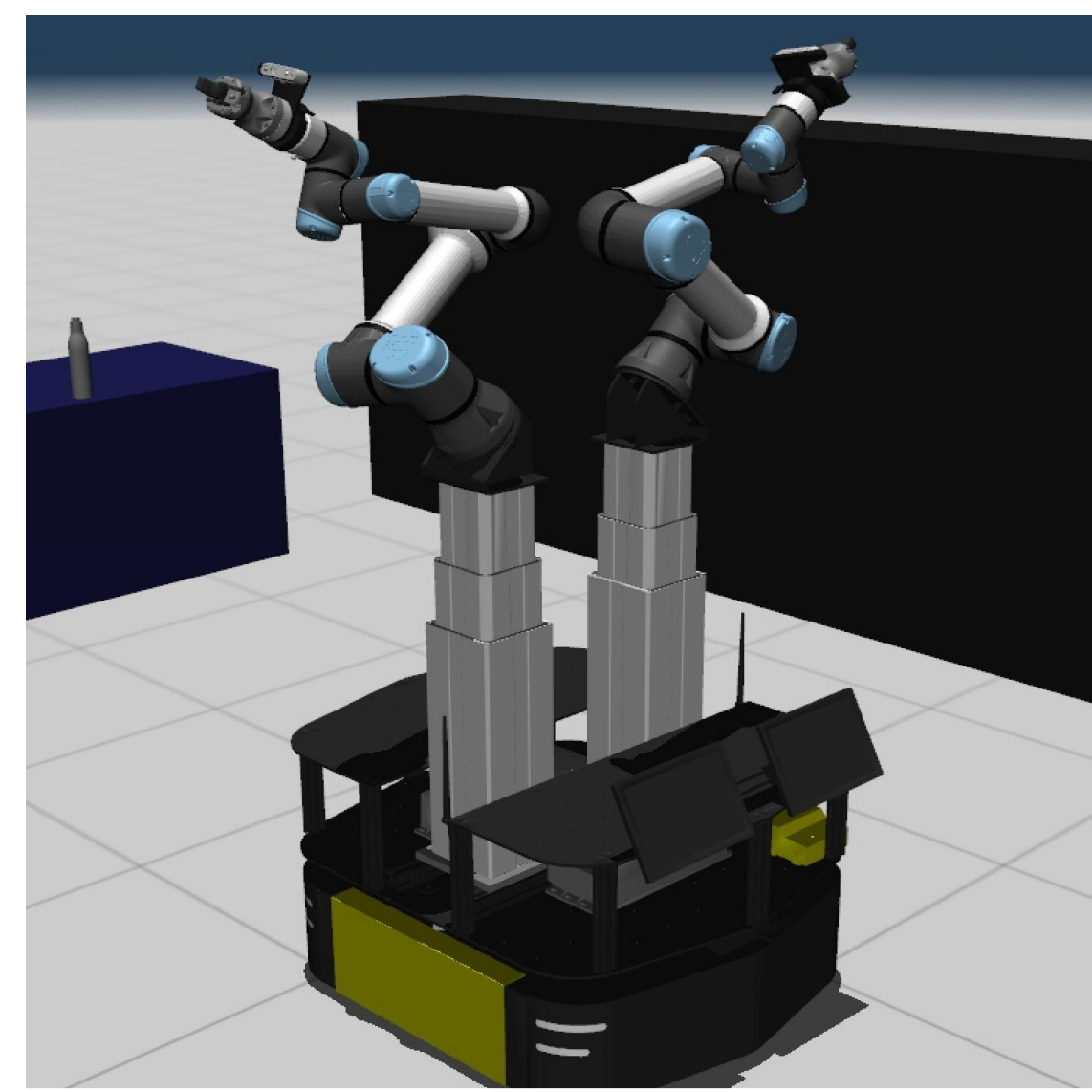
- MERLIN freezer
- Pressurized Rover hatches (multiple sizes)
- Pressurized rover cabin elements (bench seat, stowage)
- Cargo Transfer Bags (CTB)
- Gas cylinder and storage interface

Remote operations capabilities:

- Two overhead PTZ network cameras for operator awareness
- Adjustable bandwidth/latency connections with Linux Traffic Control (TC)

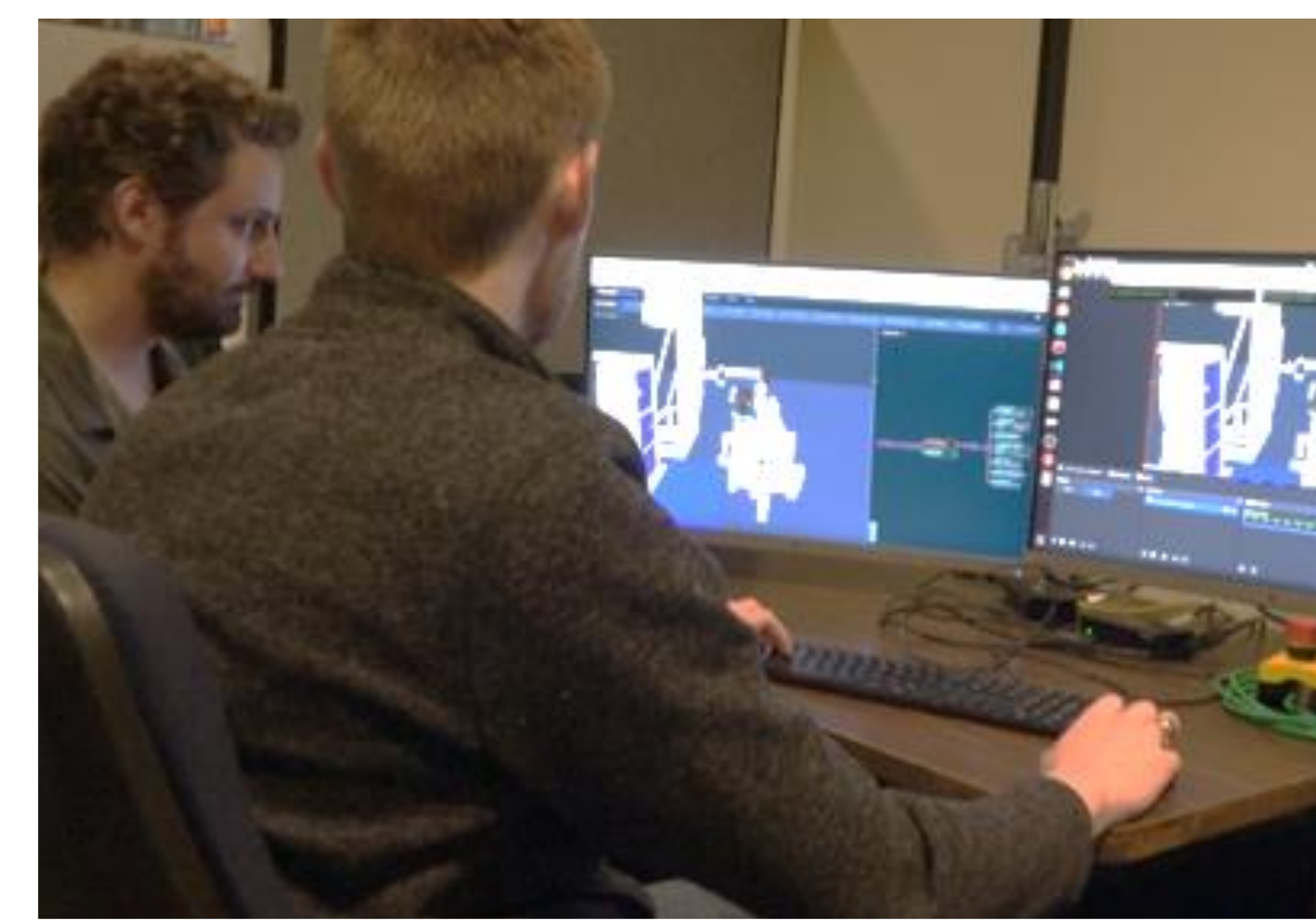


INNOVATIONS AND CAPABILITIES



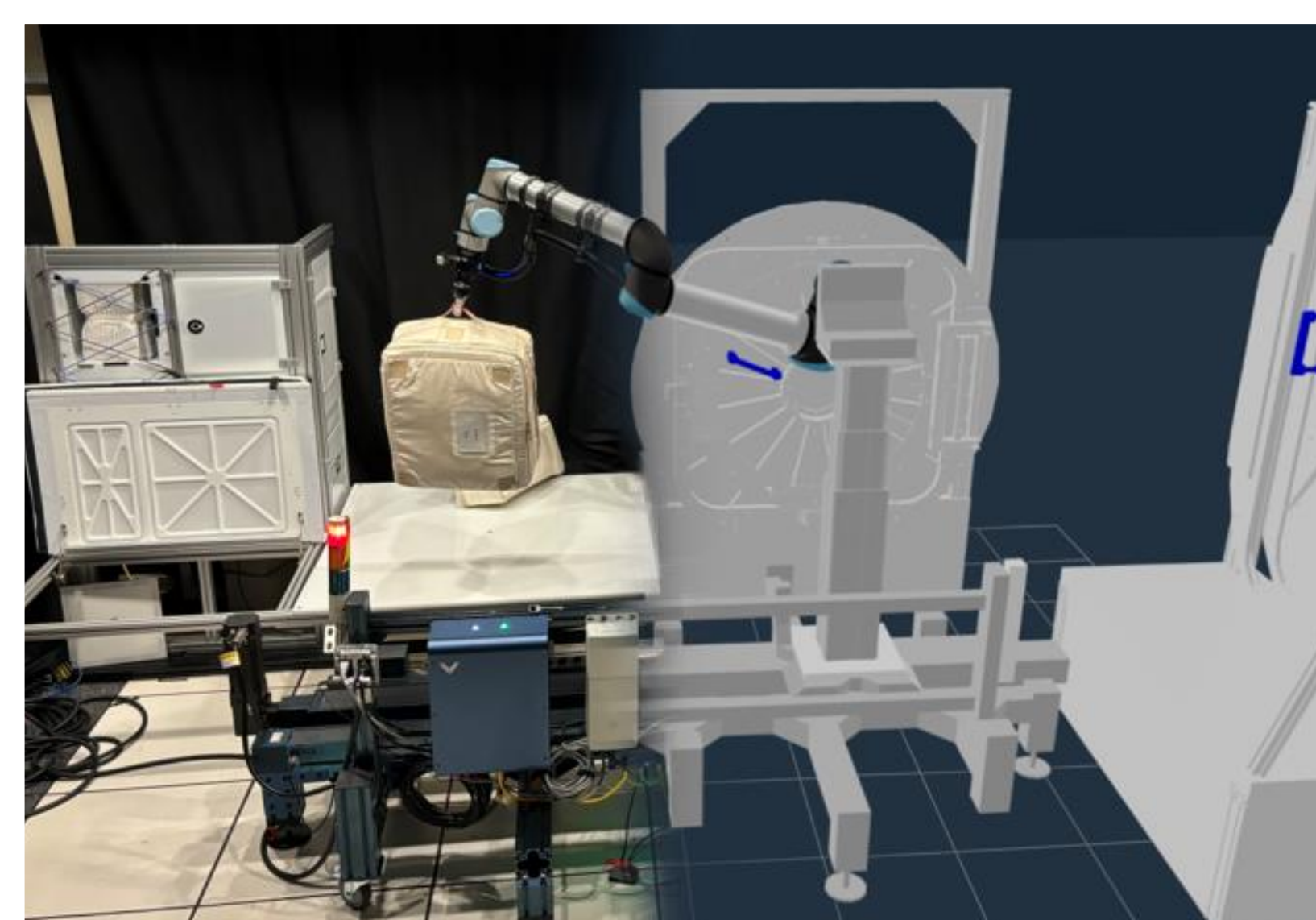
Reducing the sim-to-real gap with digital twin

- ✓ 1:1 dynamic simulations of the robotic systems and mockups has been added using **MuJoCo**.



Enabling remote operations

- ✓ Provides infrastructure to support **frequent, reliable, and cross-country** remote operations of the facility's robotic systems.



Conducting simulation + hardware-in-the-loop testing

- ✓ Combines simulation and hardware-in-the-loop testing for realistic, **end-to-end validation**.



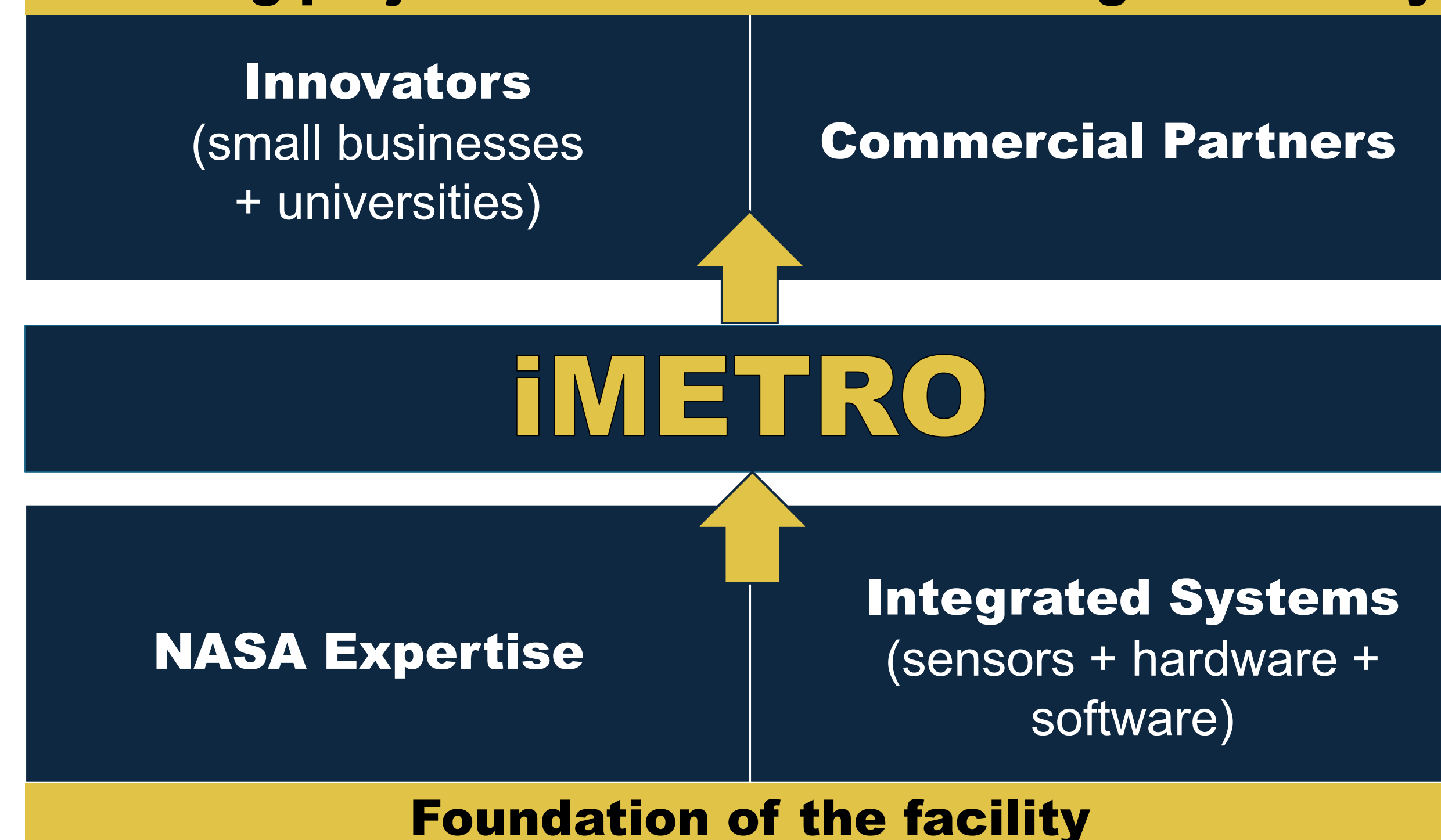
Establishing a multi-robot environment

- ✓ Enables **parallel, task specific testing** of multiple robotic systems in dedicated environments under one space.

IMPACT

iMETRO lowers barriers for innovators with non-proprietary, and current space use cases - bridging specialists to create integrated, adoption-ready solutions.

Building projects and innovations using the facility



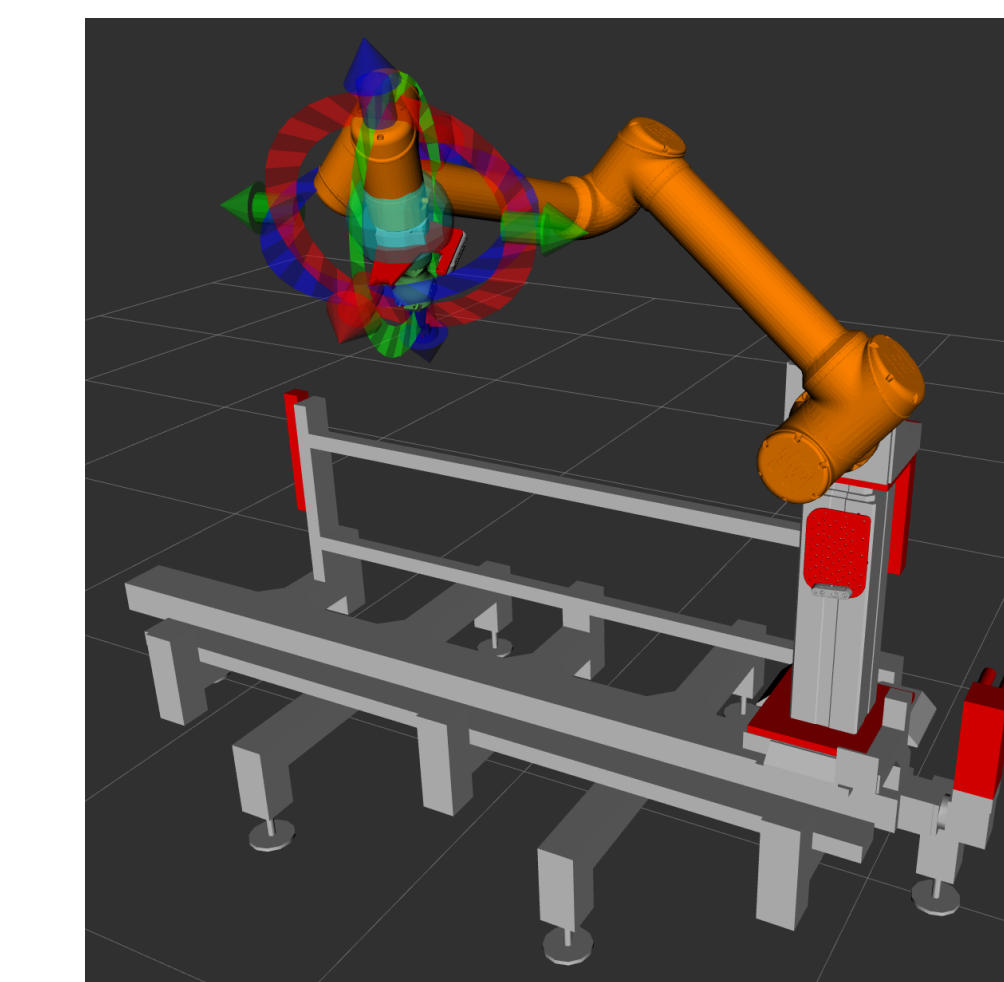
PARTNERSHIPS

iMETRO works with academic and commercial/industrial partners to develop and validate integrated space technologies. The facility also partakes in multi-center collaboration within the agency. Previous and current collaborators include:



FUTURE WORK

- Strengthening simulation realism and fidelity by validating dynamic properties of the digital twin(s)
- Exploring robotic manipulation applications in both outdoor and indoor environments, and cross-robot collaboration
- Investigating VLA-based AI systems for autonomous operation in remote environments



COLLABORATE WITH US!

Interested in exploring iMETRO capabilities? Have ideas or want to collaborate? Scan the QR code to view our open-sourced work on GitHub and connect with us.



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