The Future of Robotics in Space

The Journey from
Exploration to Commercialization

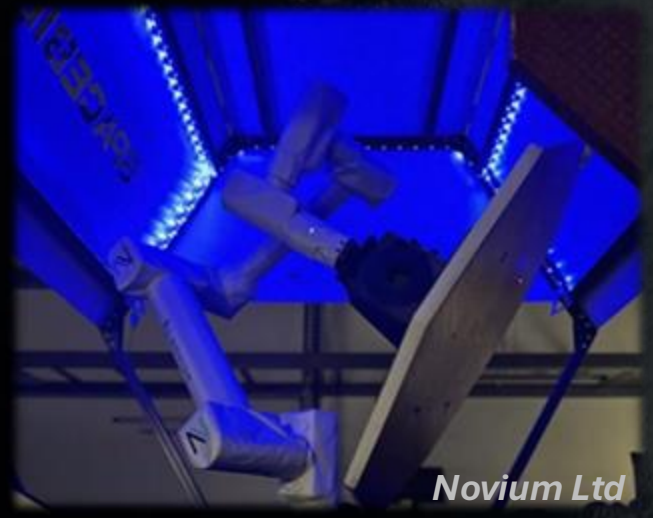
Brice Howard

Space Robotics Advocate

Space:
The $1.8 Trillion Opportunity

McKinsey & Company

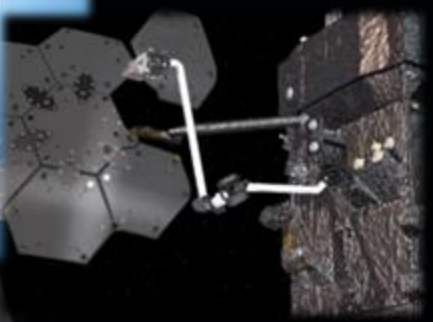
EXPLORATION → INOVATION → COMMERCIALIZATION



New Space Industry – *The Great Hope*

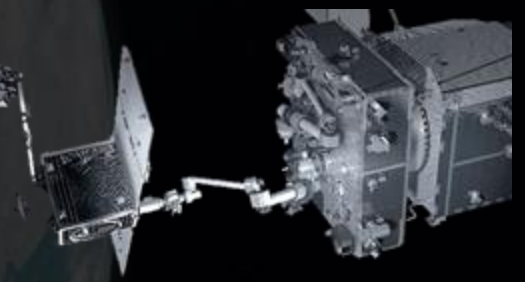






Robotics

are the equipment that will move the space industry



Todays Space Industry – Where are all the customers

2024

$135B

Government

$80B USA

$60B

Civil Market

$25B USA

$75B

Defense Market

$55B USA

$596B

Commercial

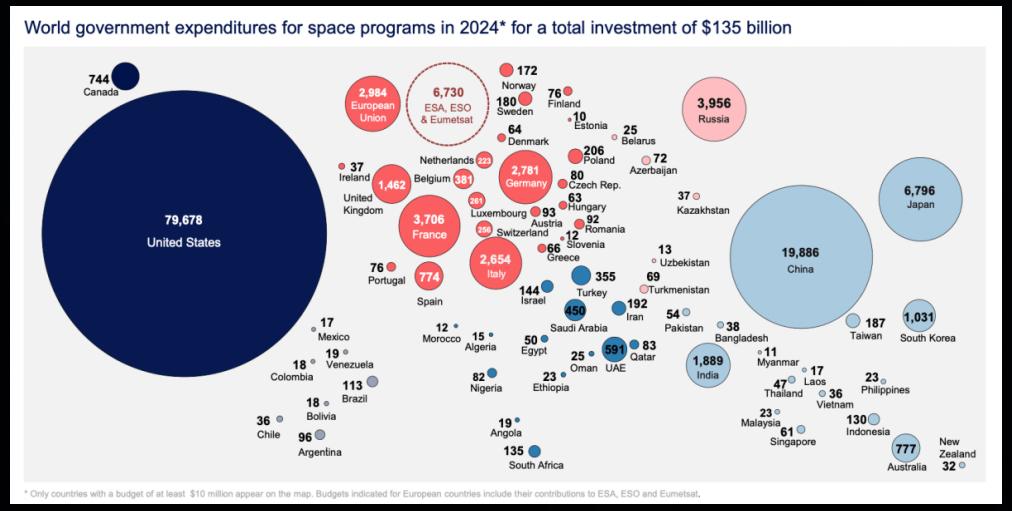
$590B

Satellite Market

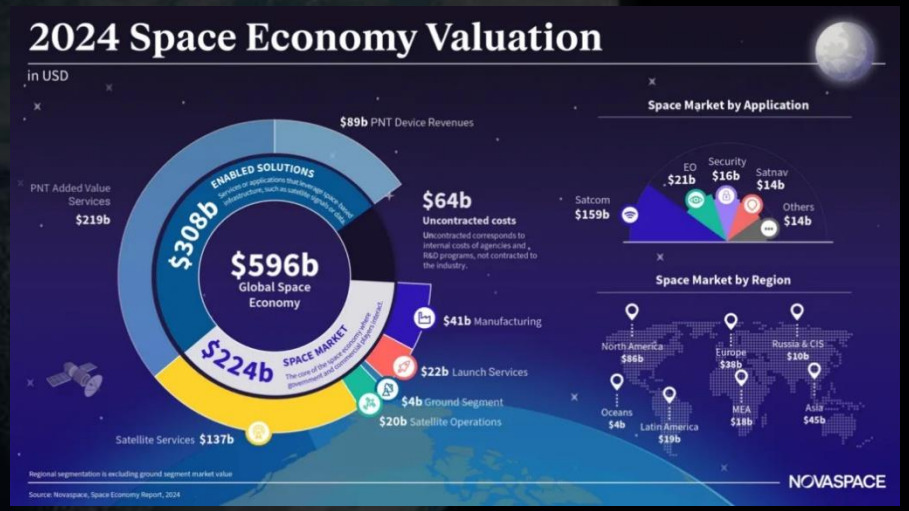
$6B

New Space Market

Private Investment



https://nova.space/press-release/defense-spending-drives-government-space-budgets-to-historic-high/



https://nova.space/in-the-loop/highlights-of-the-2024-space-economy/#:~:text=The%20space%20economy%20is%20projected,downstream%20solutions%20leveraging%20satellite%20data.

Todays State Of In-Space Robotics Technology

9

Mobility Units

1

Dynamic Grappling

12

Manipulators

Mobility Units		
Mars Path Finder	1996	Mars
Mars Exploration Rover	2003	Mars
MSL - Curiosity	2011	Mars
~~Chang'E 3~~	~~2013~~	~~Lunar - China~~
~~Chang'E 4~~	~~2018~~	~~Lunar - China~~
~~Tutu-2~~	~~2019~~	~~Lunar - China~~
Perseverance	2020	Mars
~~Zhurong~~	~~2020~~	~~Lunar - China~~
Pragyan (Chandrayaan-3)	2023	Lunar India

Manipulators		
Canadarm 1	1981	ISS
RoTeX	1993	ISS
EST-VII	1997	Satellite Servicer
Canadarm 2	2001	ISS
Orbital Express	2004	Satellite Servicer
JEMRMS	2007	ISS
Dextre	2008	ISS
~~ALONG-1~~	~~2016~~	~~China~~
Perseverance arm	2020	Mars
~~CMM (Core Module Manipulator)~~	~~2021~~	~~China~~
~~EMM (Experimental Module Manipulator)~~	~~2022~~	~~China~~
Gitai	2024	ISS

Spacecraft		
Hayabusa	2003	Lunar
ROSETTA	2014	Lunar
Hayabusa-2	2014	Lunar

Landers		
Surveyor 3	1967	Lunar
Luna 16	1970	Lunar
Luna 17	1970	Lunar
Luna 20	1972	Lunar
Luna 21	1973	Lunar
Luna 24	1976	Lunar
Viking	1975	Lunar
Phoenix	2008	Mars
insight	2018	Mars
(Chandrayaan-3)	2023	Lunar
SLIM	2023	Lunar
Intuitive Machines	2024	Lunar

Other		
ROKVIS	2004	ISS
Robonaunt	2008	ISS
Ingenuity - helicopter	2020	Mars

Todays State Of In-Space Robotics Technology

Canada 2 Arm

$1.4B

15yrs Lead

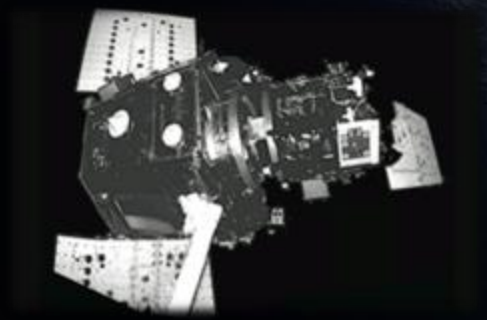
Thousands Ops Hours

Delivered
2001

Free Fly Grappling
Remotely Operated

Pick and Place
Remotely operated

Orbital Express Arm



$100M+

5Yrs Lead

~10 Ops Hours

Delivered
2004

Free Fly Grappling
Autonomous

Pick and Place
Simi - Autonomous

GITAI S2

$20M+

2Yrs Lead

~100 Ops Hours

Delivered
2024

Free Fly Grappling
NOT DEMONSTRATED

Pick and Place
Simi - Autonomous

MRV (RSGS)

$100M+

10Yrs Lead

N/A Ops Hours

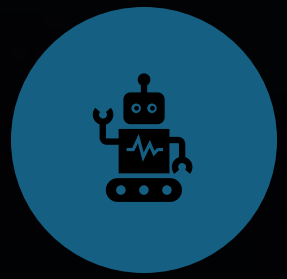
Delivered
2026 (planned)

Grappling
Autonomous

Pick and Place
Simi - Autonomous

So, what's the Problem?

Where are all the robots?



The Perception Gap:

Public perception seems to be running ahead of reality, leading to misplaced industry focus and underinvestment in critical robotics technology.

High Costs and Limited Deployment:

Space robots are expensive and fragile, preventing large-scale adoption and slowing the commercialization of space.

Bespoke Designs and Limited Testing:

Space robots are built as one-off, mission-specific systems with long development cycles, and the lack of on-orbit testing limits innovation.

Human and Supply Chain Bottleneck:

Space robotics depends on expert operators and lacks a reliable supply chain, restricting scalability and real-world applications.

We need to shift industry focus and investments

toward developing versatile, in-space tools that can support a wide range of missions and accelerate innovation.

We need an affordable, robust, and flexible robotic toolset

that can support a wide range of space missions, drive down costs, and enable scalable, repeatable operations across the industry.

We need frequent, affordable access to on-orbit testing

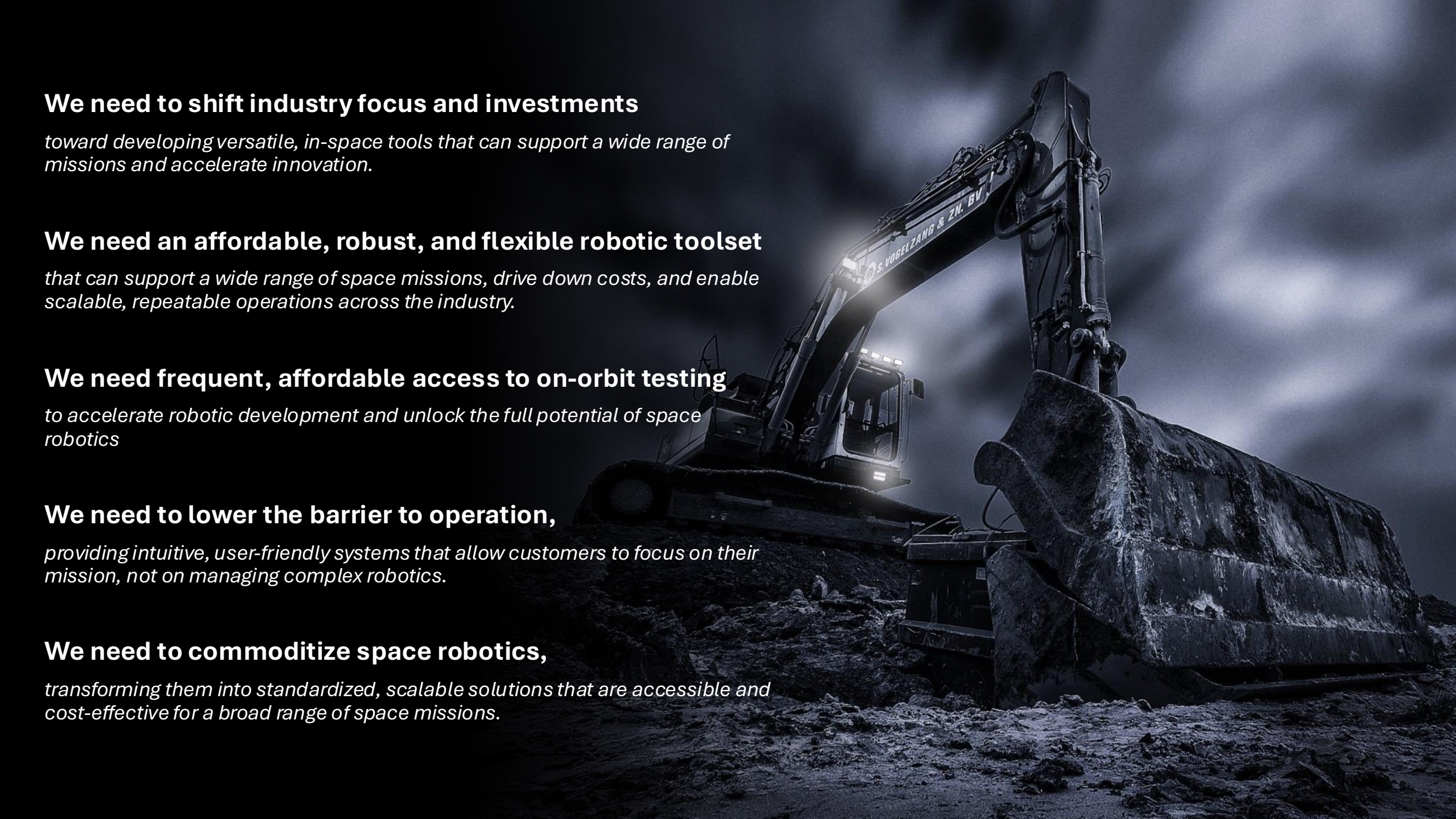
to accelerate robotic development and unlock the full potential of space robotics

We need to lower the barrier to operation,

providing intuitive, user-friendly systems that allow customers to focus on their mission, not on managing complex robotics.

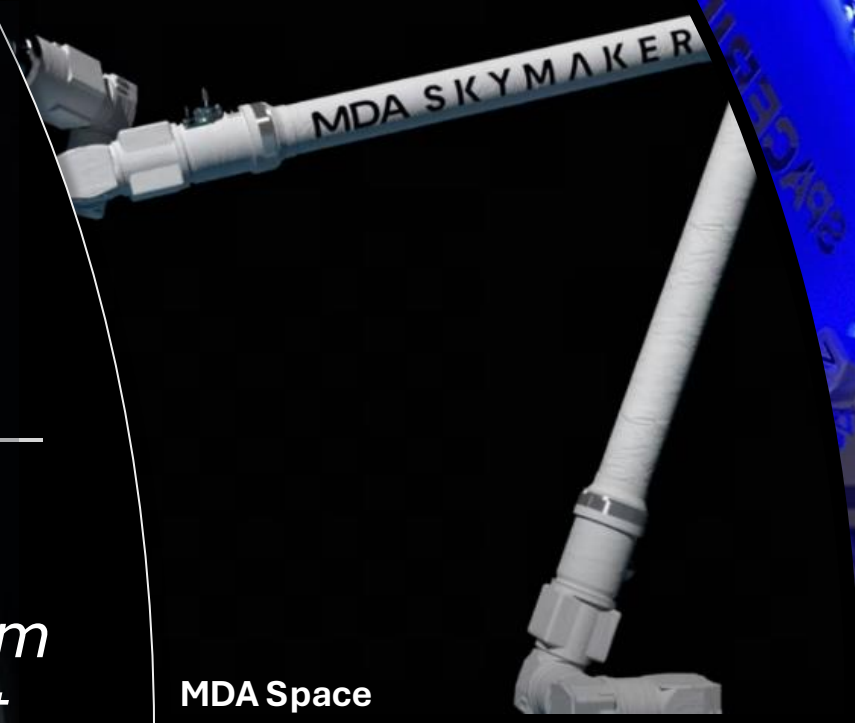
We need to commoditize space robotics,

transforming them into standardized, scalable solutions that are accessible and cost-effective for a broad range of space missions.



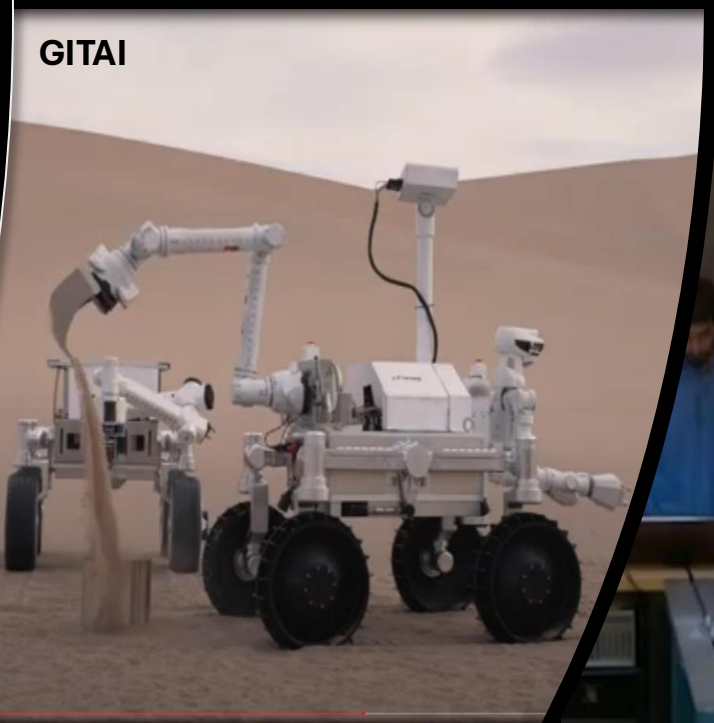
THE DEMAND IS CLEAR

Robotics must become a near term industry priority, with investment focused on developing a **low-cost, robust toolset** *that will unlock the next frontier of space commercialization.*



MDA Space


Novium


GITAI


Motive Space

Next Steps

Focus on deploying Technology Fundamentals

On-Orbit Logistics

- Environmental Rugged Hardware
- Communication Network
- Workspace Mapping
- Standardized Interfaces
- Robotic Dynamic Grappling (Autonomous)
- Robotic Pick and Place
- GET INTO SPACE
- Remote Operations

Remote Operations

Lunar Logistics

- Environmental Rugged Hardware
- Communication Network
- Navigation (Lunar PNT)
- Workspace Mapping
- Standardized Interfaces
- ~~Robotic Dynamic Grappling~~
- Robotic Pick and Place
- Remote Operation

NOVIUM

https://www.noviumdesigns.com/space-robotics

https://www.youtube.com/watch?v=4-hEH0dLMhI&list=PPSV

Improving Life on Earth

Aviation

- Environmental Rugged Hardware
- Communication Network
- Landing Contact Dynamics
- Remote Operations

Remote Operations

Mining

- Environmental Rugged Hardware
- Communication Mesh Network
- Navigation
- Workspace Mapping
- Standardized Interfaces
- ~~Robotic Dynamic Grappling~~
- Robotic Pick and Place
- Remote Operation

NAVY Unmanned aircraft

Underground mine tunnels with mobile communication mesh network

Underground Drill rig

A Call to Action

Help Align Perception with Reality

Raise awareness of where space robotics truly stands today. We need more science, less science fiction! There is lots of work, lets get busy

Advocate for Investment in Scalable, Low-Cost Robotics

Shift funding toward robust, affordable robotic solutions that drive mission success and industry growth. Remote operations will be the cornerstone of the industry

Unite as a Robotics Community

Collaboration, not competition, will accelerate progress. Let's support each other's successes and push the field forward together

Make Robotics the Industry Priority

Space robotics isn't just a tool—it's the key to unlocking the next era of space commercialization.

Questions

Brice Howard

Space Robotics Advocate

Brice.a.howard@gmail.com

702-400-2438