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Mission Critical — Simulate First

With NVIDIA Omniverse ™

Presenter

Lutz Richter is Space Projects Expert at SoftServe with over 25 years of experience in space robotics. He has contributed to major missions with ESA, NASA, and JAXA, including ESA's Rosetta and Mars Express (Beagle 2), NASA's Mars Exploration Rovers, and JAXA's Hayabusa-2 with the MASCOT lander.

Lutz has led the development of planetary rover mobility and sampling systems, notably for ESA's ExoMars mission. He also spearheads instrument development for upcoming lunar missions and serves as 1st Vice President of the International Society of Terrain-Vehicle Systems (ISTVS), supporting global research in terramechanics and lunar exploration.

Lutz Richter

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Robotics & Advanced Automation, SoftServe
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Agenda

01 NVIDIA Omniverse 101

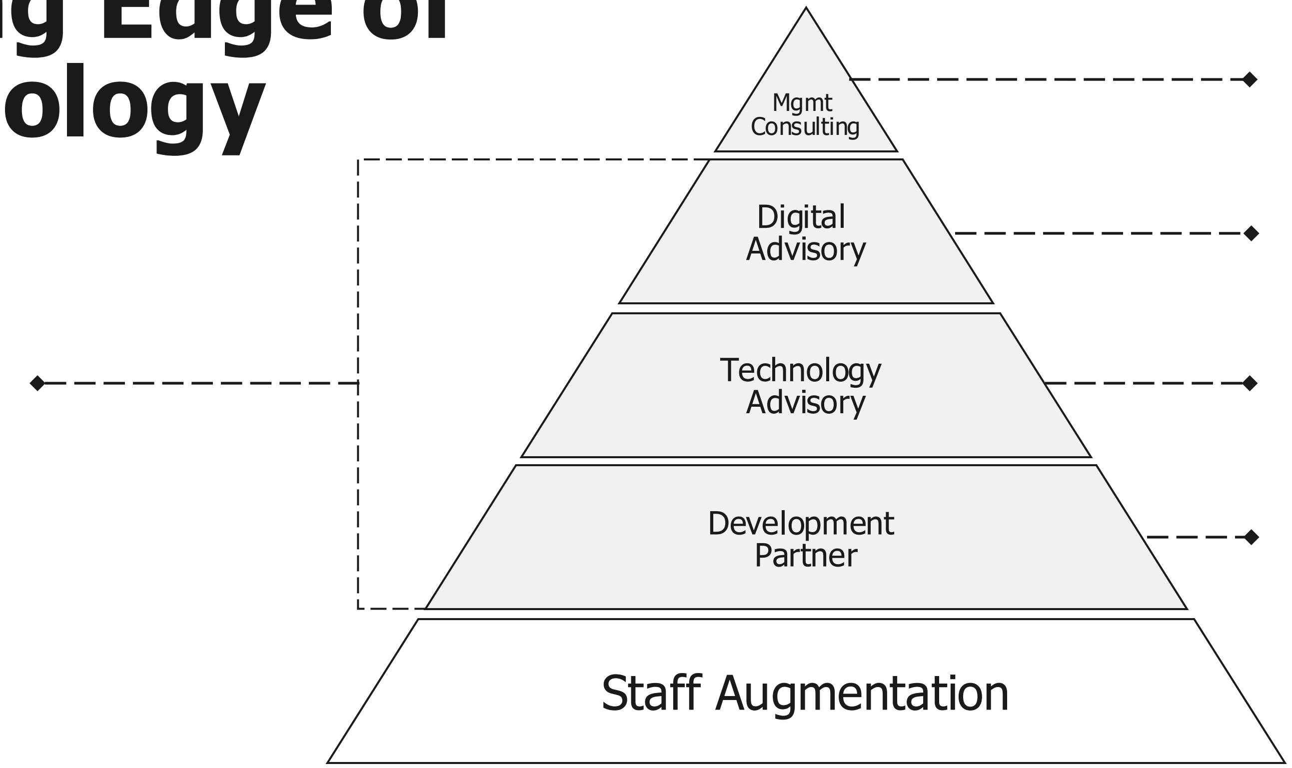
02 The space domain: Trends and pains

03 Space use cases with the Omniverse

04 Takeaways

We are Advisors and Providers who Operate at the Cutting Edge of Technology

Where softserve operates



How We Fit with Consulting Partners

We translate your vision into concrete actions and deliver results

Our Advisory division can complement your efforts with specialized technical expertise

Our world-class engineering know-how enables us to offer strategic advice on the best technology solutions

Our high-quality teams integrate seamlessly with yours to deliver high-quality solutions

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SoftServe Space Robotics Practice: Built On NVIDIA Omniverse™

DIGITAL TWIN & ROBOTICS

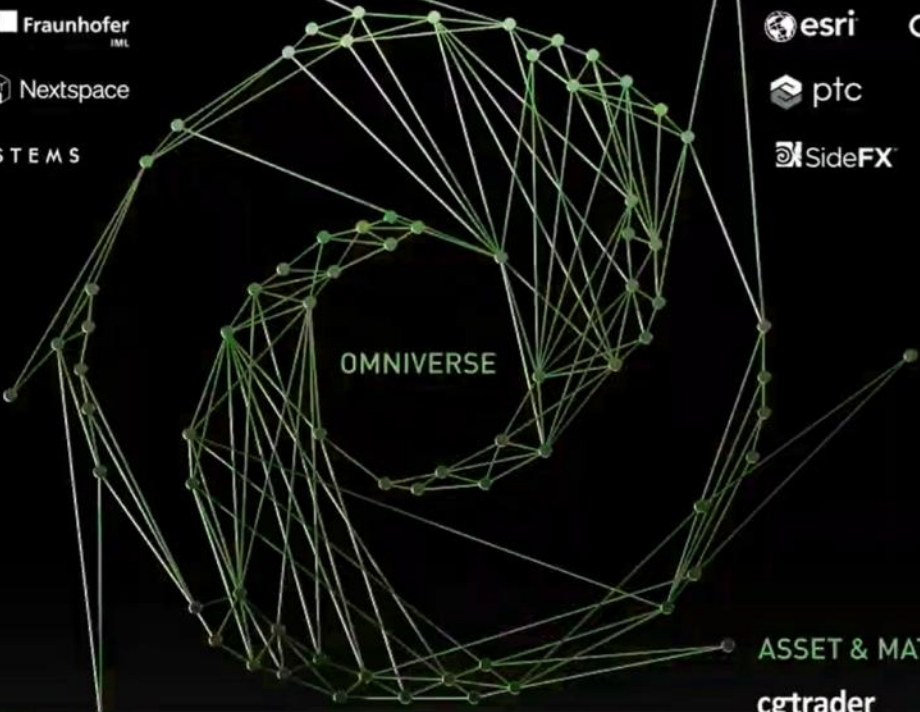
amazon robotics, aspentech, AUTODESK, Bentley, DELTA, esri, FESTO, FUJISOFT, FLEXIV, Fraunhofer IML, HALODI robotics, idealworks, ipolog, ptc, Nextspace, RIOS, READY ROBOTICS, SIEMENS energy, 6 RIVER SYSTEMS, Trimble, VISUAL COMPONENTS

DESIGN & CONTENT CREATION

Adobe, AUTODESK, blender, CLO Virtual Fashion, esri, GRAPHISOFT, kitware, MAXON, ptc, PLANTFACTORY, Rhinoceros, REALLUSION, SideFX, Trimble

SYSTEMS INTEGRATORS

kineticvision, Deloitte., NETALLIED SYSTEMS, quantiphi, softserve



RENDERING

AUTODESK, blender, chaos, MAXON, otoy, RENDERMAN

SENSOR MODELS

Ansys, Continental, HELLA, LUMINAR, SONY, Valeo

ASSET & MATERIAL LIBRARIES

cgtrader, REALLUSION, Sketchfab, TURBOSQUID by shutterstock, twinbru

82 Connections

150k Downloads

106k Unique Users

NVIDIA

SOFTSERVE AND NVIDIA

A strategic partnership for scalable innovation

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ELITE SERVICE DELIVERY PARTNER STATUS

NVIDIA Elite Partner

NVIDIA Partner Awards
EMEA 2024
Outstanding Impact Partner of the Year

NVIDIA Partner Awards
Americas 2025
Service Delivery Partner of the Year

150+

People experienced in NVIDIA stack and Professional Services as an Elite SDP

750+

Experts in BigData, AI/ML, Robotics, IoT, AR/VR and R&D

GLOBAL LAUNCH PARTNER FOR OMNIVERSE

Dedicated Omniverse Competency Team being deployed, capable of developing connectors, extensions, IsaacSim robotic simulation, CloudXR, and heavy focus around Digital Twins industrial solutions.

NVIDIA Omniverse™

EXPERTISE IN USING GPUS IN THE CLOUD

1,200+

Cloud Experts

We have the highest level of partnerships with AWS, GCP, Azure and OCI.

Google Cloud GLOBAL Partner of the Year Machine Learning 2020

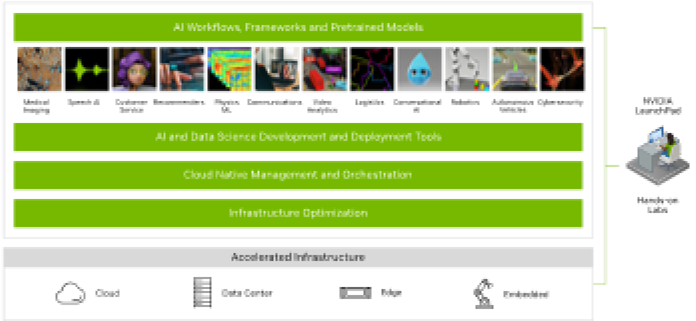
aws PARTNER Premier Tier Services

Microsoft Solutions Partner Data & AI Azure Specialist Analytics

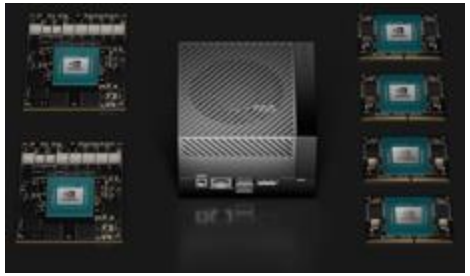
ORACLE CLOUD

NVIDIA OMNIVERSE EXPLORER GLOBAL LAUNCH PARTNER

NVIDIA AI ENTERPRISE SERVICE DELIVERY PARTNER



EMBEDDED EDGE COMPETENCY PARTNER



Why Space Needs Smarter Systems

Key Trends

Use Cases in Earth Orbit and beyond

- *Responsive space*
- *Dynamic space*
- Space "warfighting"
- Compromised communications
- Rendezvous and proximity operations (RPO):
  - OOS, inspection, dynamic space
- More extensive autonomy
- Planetary robotics: autonomous sampling
- XR in Humanoid Robot teleoperation and training

Common Denominators

- Need for fuller autonomy (disrupted comms or large latency)
- More comprehensive sensor suites

Important Driver: Price of space robotic systems

Global Themes For In-space Technologies

EYES ON EARTH AND BEYOND

- Imaging Earth in various wavelengths to monitor the environment, detect change, and ensure security
- Used by public agencies and private companies
- Orbiters explore the Moon and other planets
- Advanced instruments now collect more data

CONNECTIVITY AND COMMUNICATIONS

- Large groups of satellites, called mega constellations, deliver data services around the world
- Operations of multi-robot architectures

SPACE ROBOTICS IN EARTH ORBIT

("SUSTAINABLE SPACE")

- On-orbit servicing / satellite life extension (OOS)
- Space Situational Awareness (SSA): flyby's, inspections
- Active removal of defunct satellites and upper stages (ADR)

LUNAR AND PLANETARY ROBOTICS

- Enabling sustainable lunar missions by astronauts: scouting for reserves and their exploitation (ISRU)
- Crewed lunar landers
- Robotics in concert with astronauts
- Using XR for teleoperations

Operations Scenario: Limited Autonomy Coupled With Teleoperations via VR/XR

Semi-autonomous humanoid robots perform:

- Assembly
- Maintenance
- Scientific tasks

Operated via VR/XR interfaces from:

- Earth
- Lunar Gateway

Capabilities
Digital twin interface for immersive control

Local autonomy for:

- Grasp planning
- Navigation on irregular terrain
- Real-time error correction
- Safety in dynamic environments

Free Space: ISAM Scenarios
In-space assembly and manufacturing (ISAM)

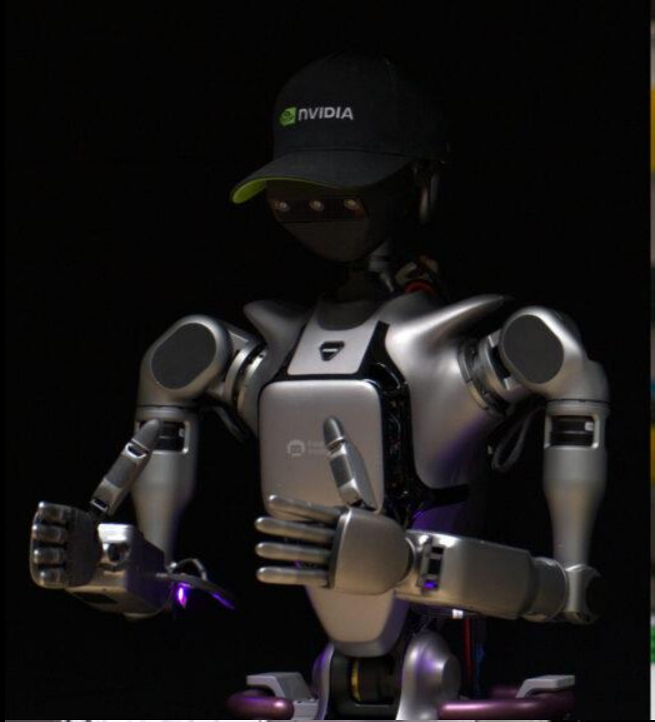
- Large structure and station assembly
- Reduces astronaut EVA time

Operated via high-level telecommands through VR/XR

Across all scenarios

Humanoid–astronaut collaboration

- Shared tasks
- Enhanced mission flexibility
- Safer, more efficient operations



Space Projects

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PAINS + HOW NVIDIA OMNIVERSE HELPS

PAIN		WITH OMNIVERSE
Incomplete testing due to budget and time limits – mission risk	→	Full system simulation with environment **digital twinning** Virtual commissioning (VC) and software-in-the-loop (SIL) testing
Quality issues in production and testing	→	**Digital twin** of production sites using industrial metaverse and XR tools
Space robotics – hardware and prediction challenges	→	High fidelity (co-)simulation of robots, sensors, and controls AI-enhanced control and training with synthetic data
Managing satellite formations and space debris is complex	→	Tools for orbit control (active S/C) and encounter prediction
Hard to map and assess usable space resources	→	**Digital twinning** of geology, and AI for resource analysis

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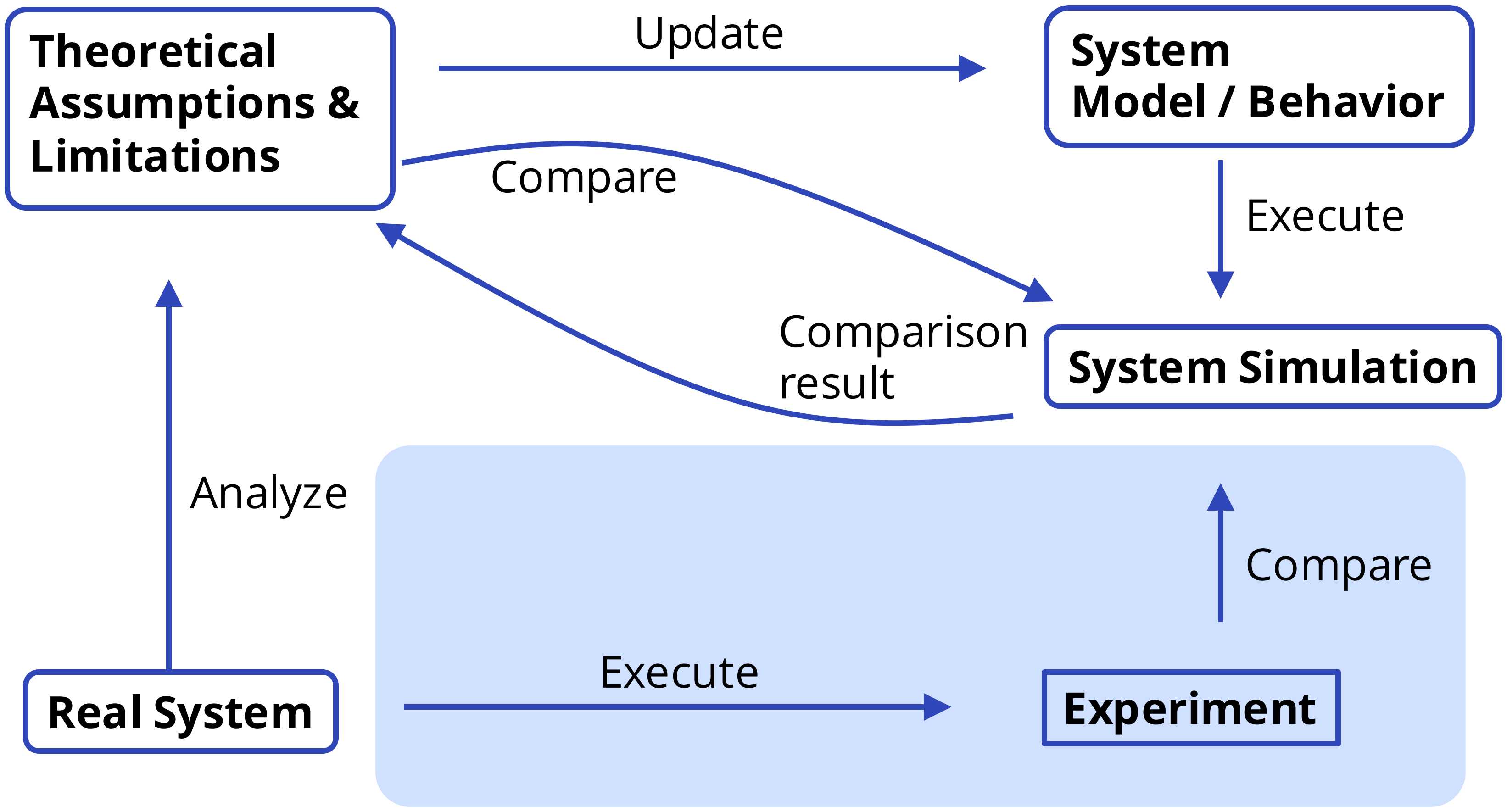
NVIDIA Omniverse™ Use Cases at SoftServe

Simulation-first: reduce risk, cost, & time

30%
Duration saving

27%
Cost saving



Your **developers can train, simulate, and validate advanced robotic systems through virtual robot learning and testing**. It happens in **physics-based digital representations** of environments, prior to deployment.

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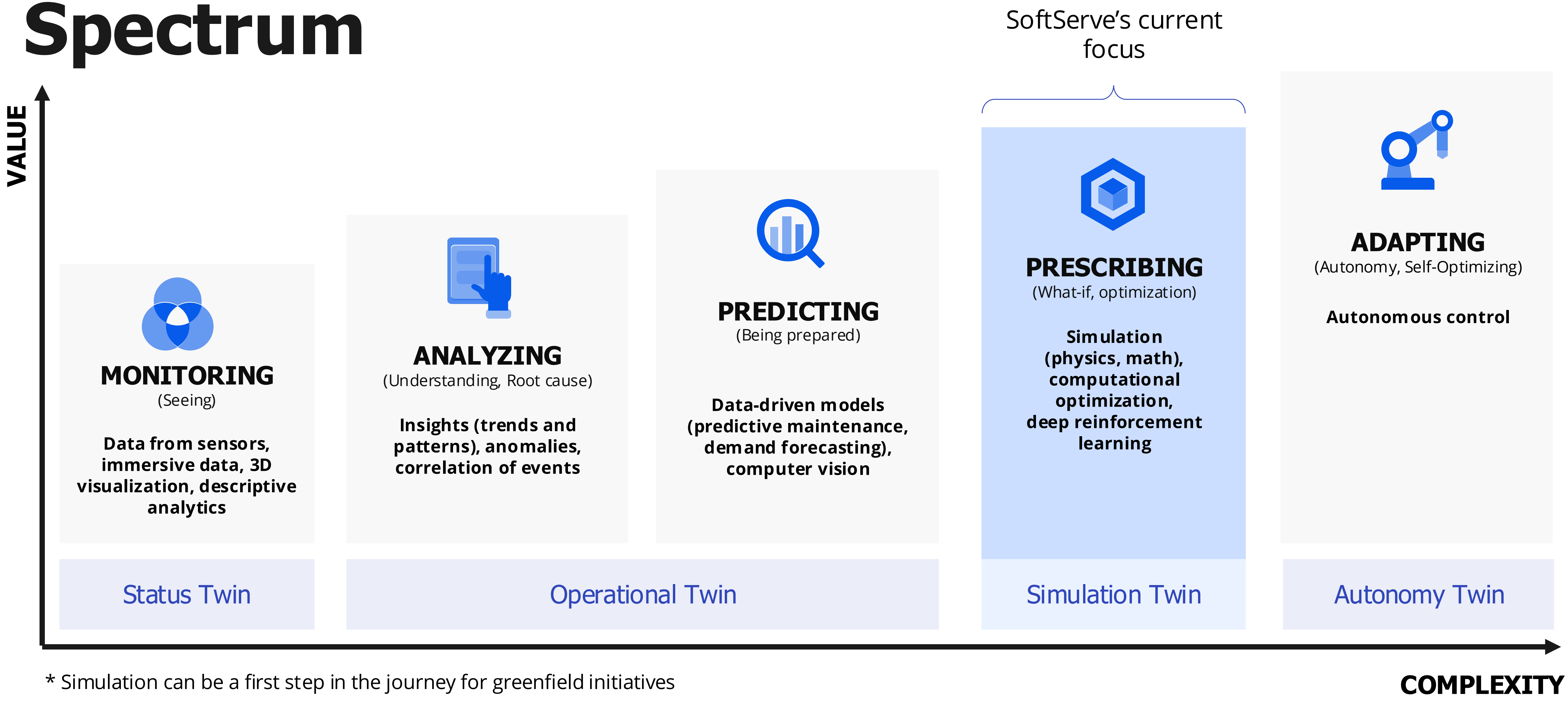
Digital Twins Spectrum



* Simulation can be a first step in the journey for greenfield initiatives

SoftServe Lunar Drone Simulation

VALUE

- Conceptual design of a thruster-driven lunar drone
- Full-flight simulation of a mission through a lava tube using a skylight as entry/exit
- High-fidelity modeling in Isaac Sim for rapid iteration and validation

CHALLENGES

Lunar ISRU & SCIENCE:

Thruster-powered drone for flying over the Moon to search for ice

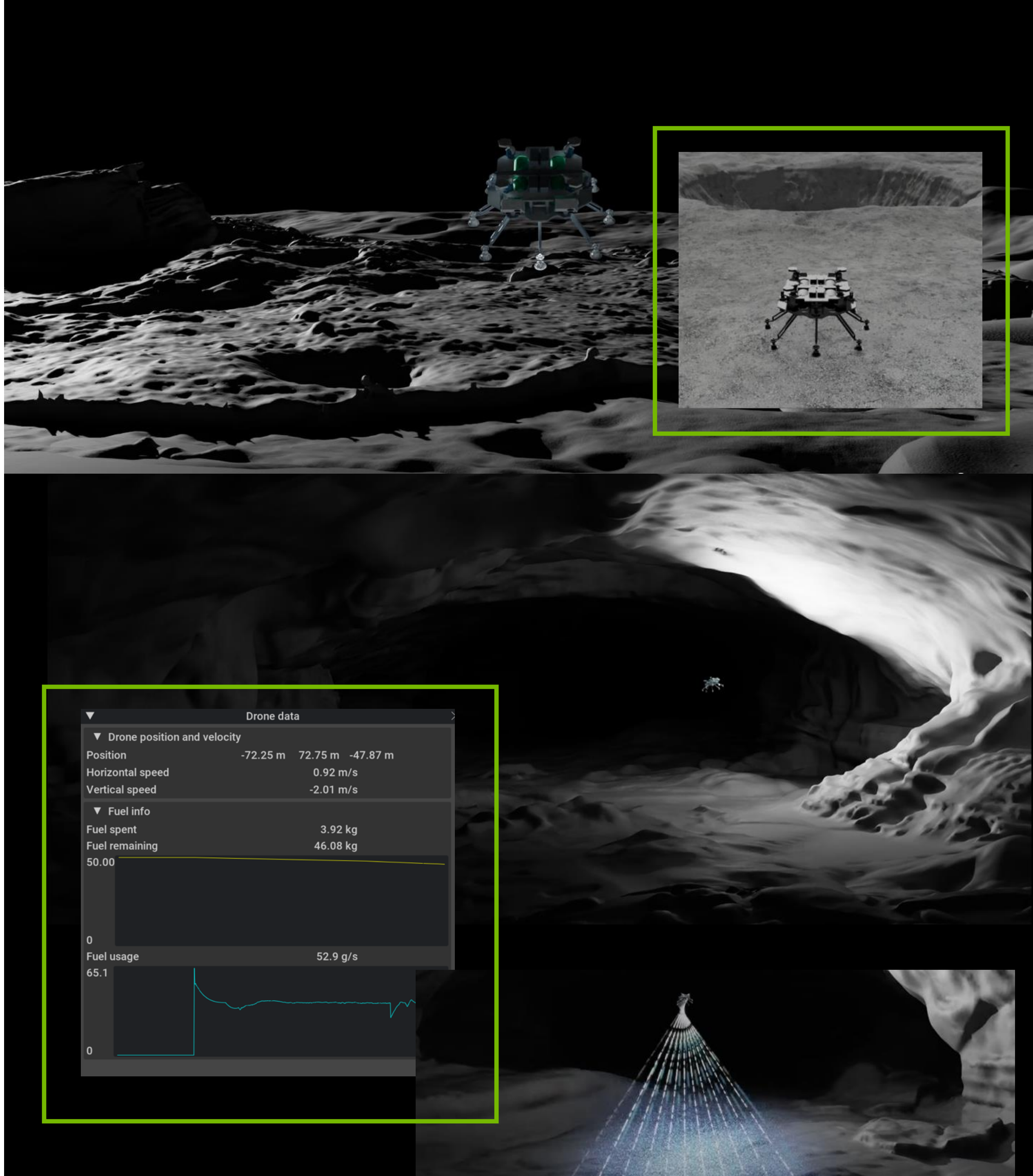
GNC system assessment needed for safe, controlled flight

Drone also considered for carrying instruments into lunar caves

Goal: analyze ice deposits using onboard mass spectrometer

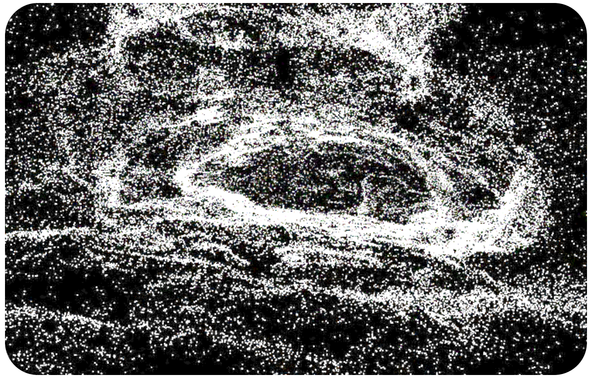
SOLUTION

SoftServe designed a notional vehicle concept along with its guidance system. Using ROS2 and NVIDIA Isaac Sim, the vehicle with its sensors and control system was modeled, and simulations performed of flights over a synthetic lunar landscape created in Blender.

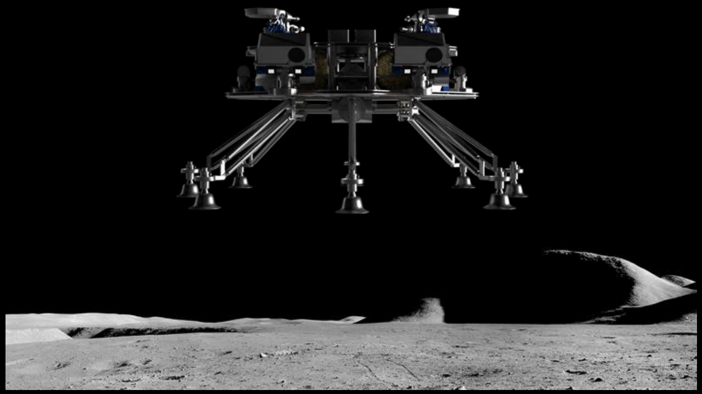


SoftServe Lunar Drone Simulation

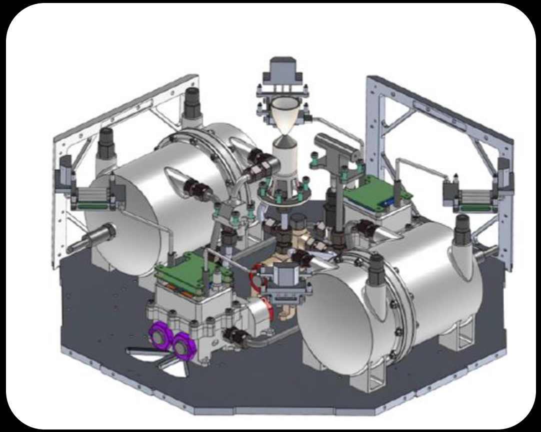
- Thruster driven vehicle for controlled flights with option for refueling
- Flight control sensors: two monocular cameras and an IMU
- Linear Kalman filter for sensor fusion and state prediction
- Sensors feeding a visual SLAM algorithm (simultaneous localization and mapping), performing autonomous navigation to reach pre-assigned targets while generating a map via point clouds



Point cloud example from simulated flight through lava tube



Vehicle with two camera heads



Propulsion system

Modeling of Lunar Lava Tubes

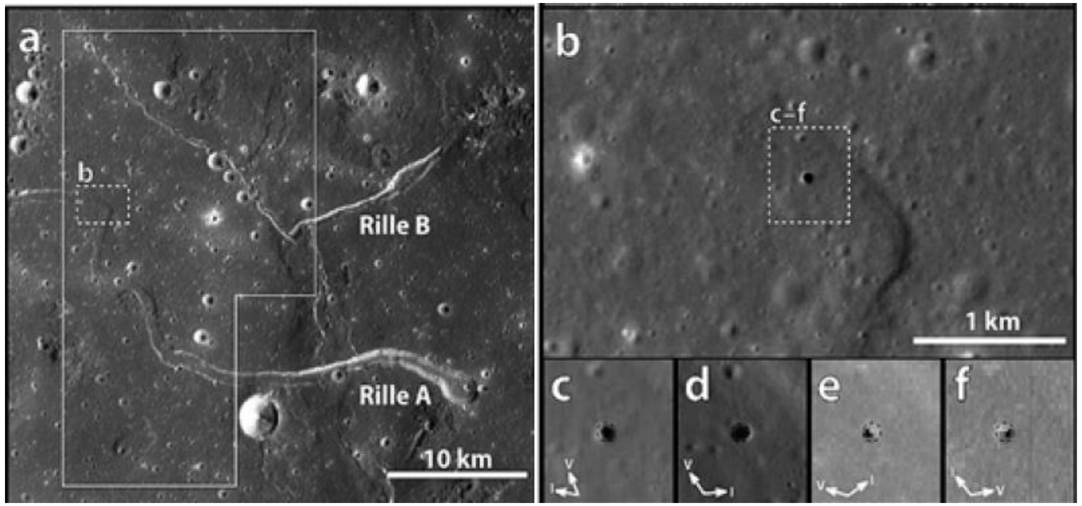
Recreated an example terrain and lava tube model using lunar satellite data and published models on lunar skylights and pits

- ✓ Skylights imaged from lunar orbit; presence of lava tubes inferred from orbiting ground penetrating radar measurements (e.g., from KAGUYA lunar orbiter)

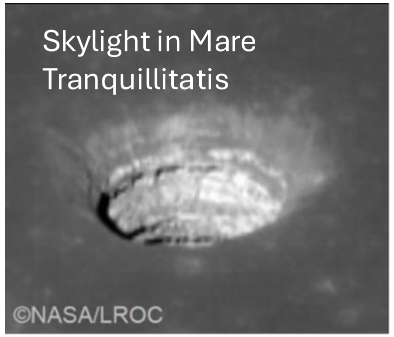
Lava tubes are an exciting features on the Moon because they could be a “safe haven” (protected from thermal extremes and radiation) for future crewed outposts.

- ✓ Moreover, some could be harboring ice (easier to access than in polar shaded regions).

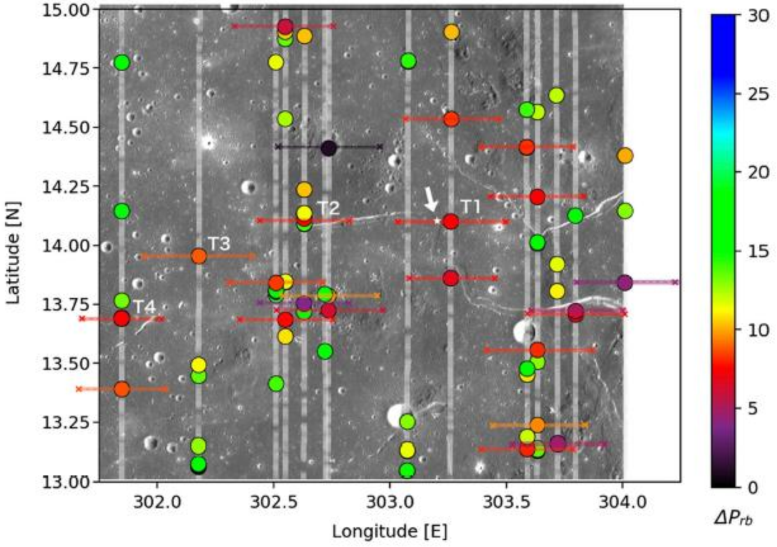
*Potential image of a lunar lava tube skylight with a diameter of 65 m in the Marius Hills area. (**a**) Panoramic view of the region, showing the designated area for crater counting marked by a solid white polygon. (**b**) Marius Hills Hole (MHH). (**c**–**f**) Magnified images of the MHH, with arrows indicating the direction of sunlight illumination (I) and camera perspective (V).*



(Qiu et al., 2023)



Candidate sites of potential underground caverns in the Marius Hills region. The color of the circles represents the radar power difference between the first and second echo peaks (DPrb). The lower the DPrb value, the greater the possibility of the existence of underground lava tubes.



Modeling Of Synthetic Lunar Terrain: Using NVIDIA Replicator

VALUE

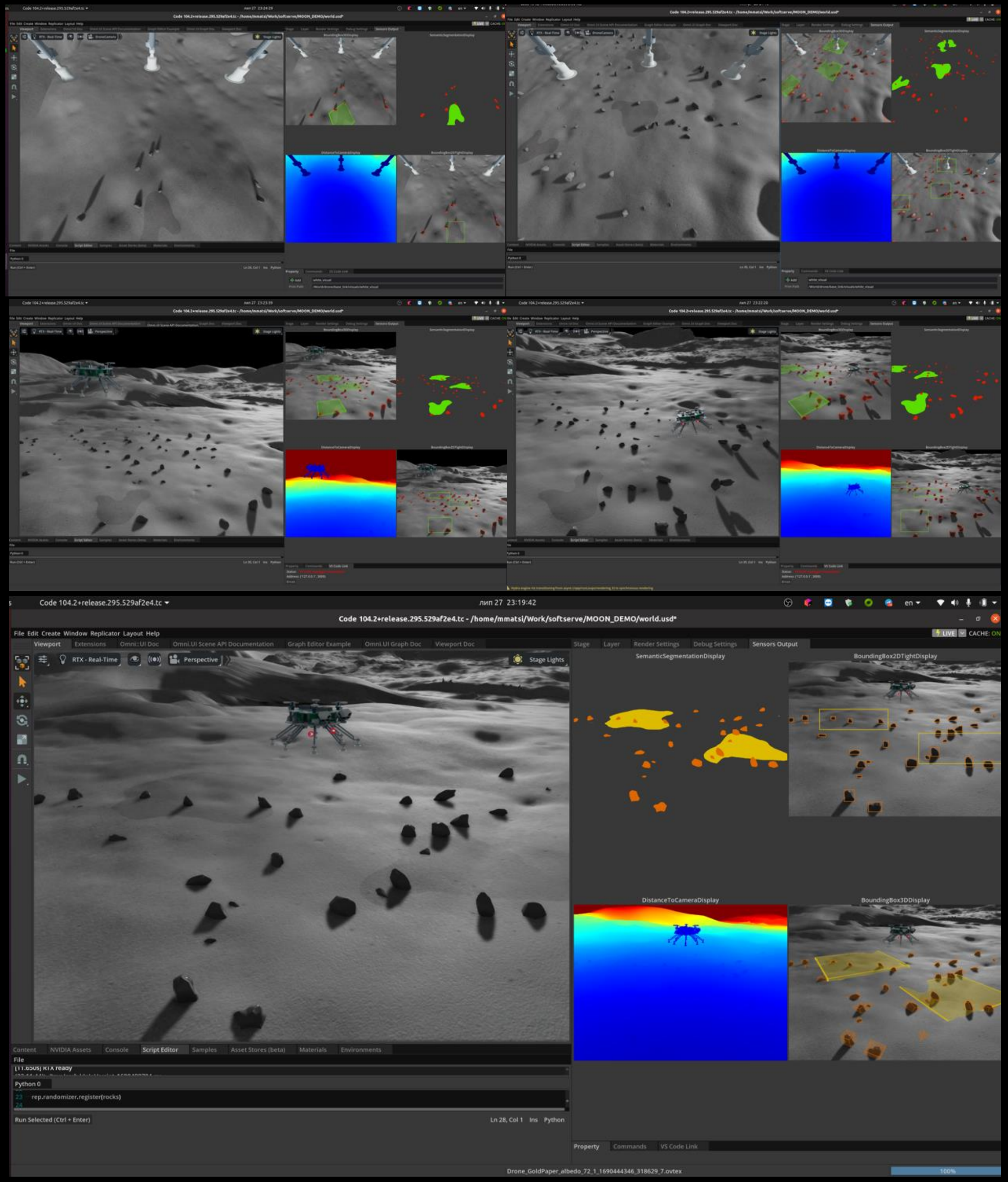
- Increased the quality of the designed drone mapping algorithm
- Enabled synthetic dataset generation for obstacle recognition
- Decreased the time needed for environment randomization

CHALLENGES

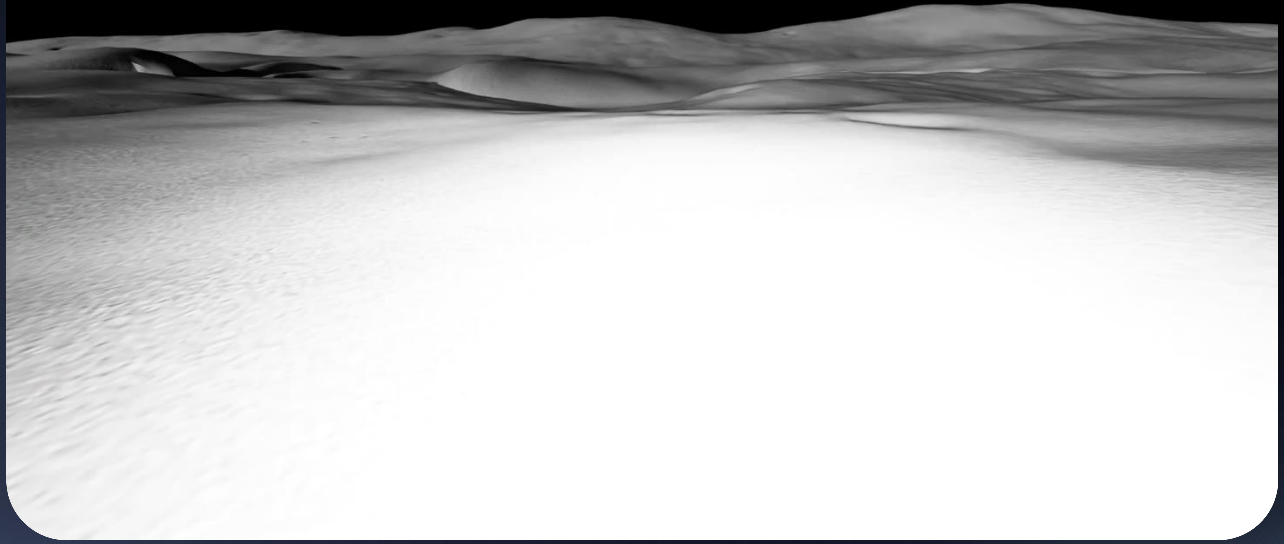
As part of the lunar drone simulation work by SoftServe:
Reduce implementation time through automatic world modification

SOLUTION

- Use NVIDIA Replicator and Isaac Sim for environment randomization
    - Drone position
    - Stone quantity, shape, and size
- Test the algorithm in various environments
- Fine-tune the algorithm based on test results
- Enable obstacles recognition for safe landing



A Glimpse Into The Virtual Mission



Simulation of flight through a lunar lava tube

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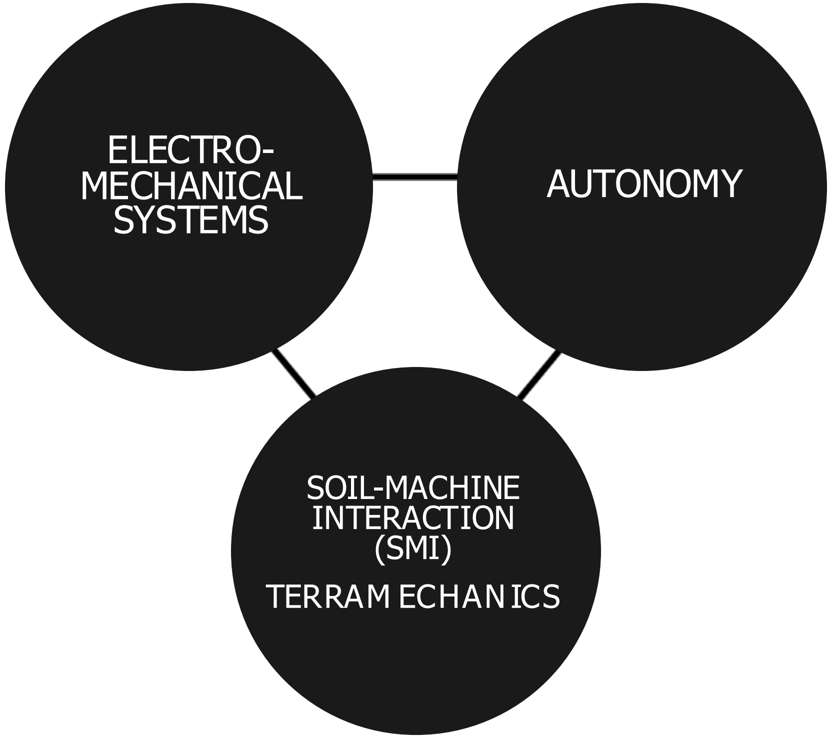
Co-simulation for Lunar Robotics

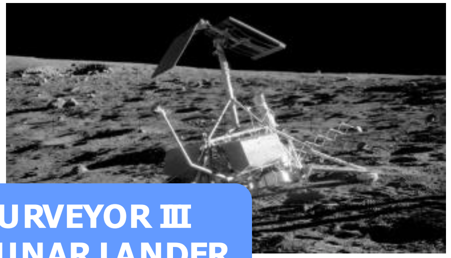
Managing energy use is critical for lunar operations.

SoftServe uses a co-simulation approach to model **tool-regolith (terramechanical) interaction and robotic behavior**.

Applications:

- Landing gear
- Rover mobility systems
- Excavation, sampling, and sample handling




SURVEYOR III LUNAR LANDER


APOLLO LM FOOTPAD


MER MARS ROVER WHEEL


EXOMARS SPDS: SAMPLE METERING STATION

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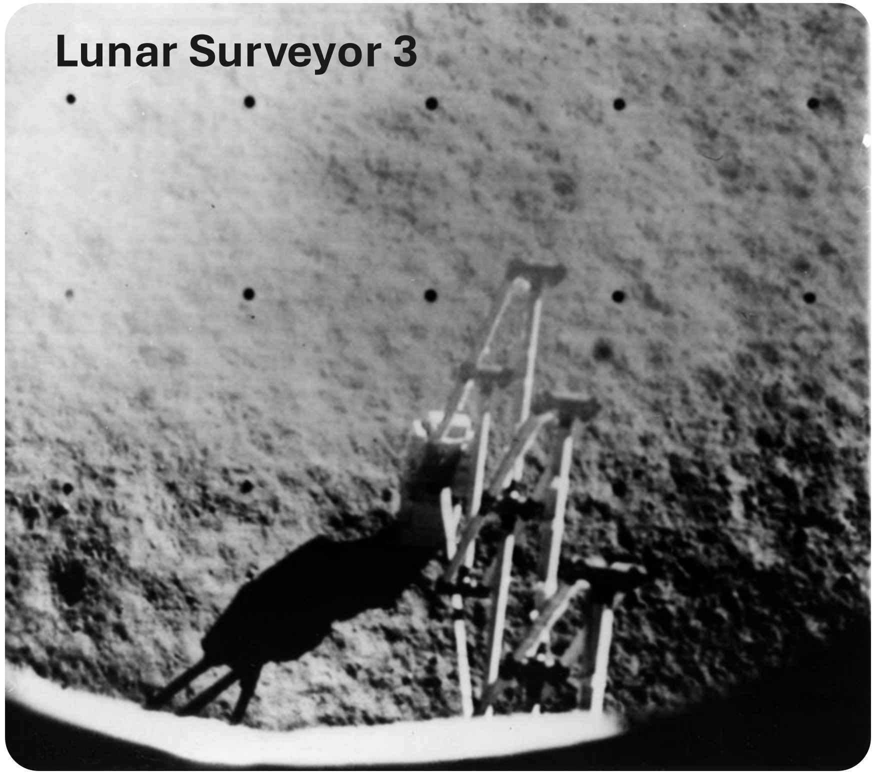
Excavation On The Moon

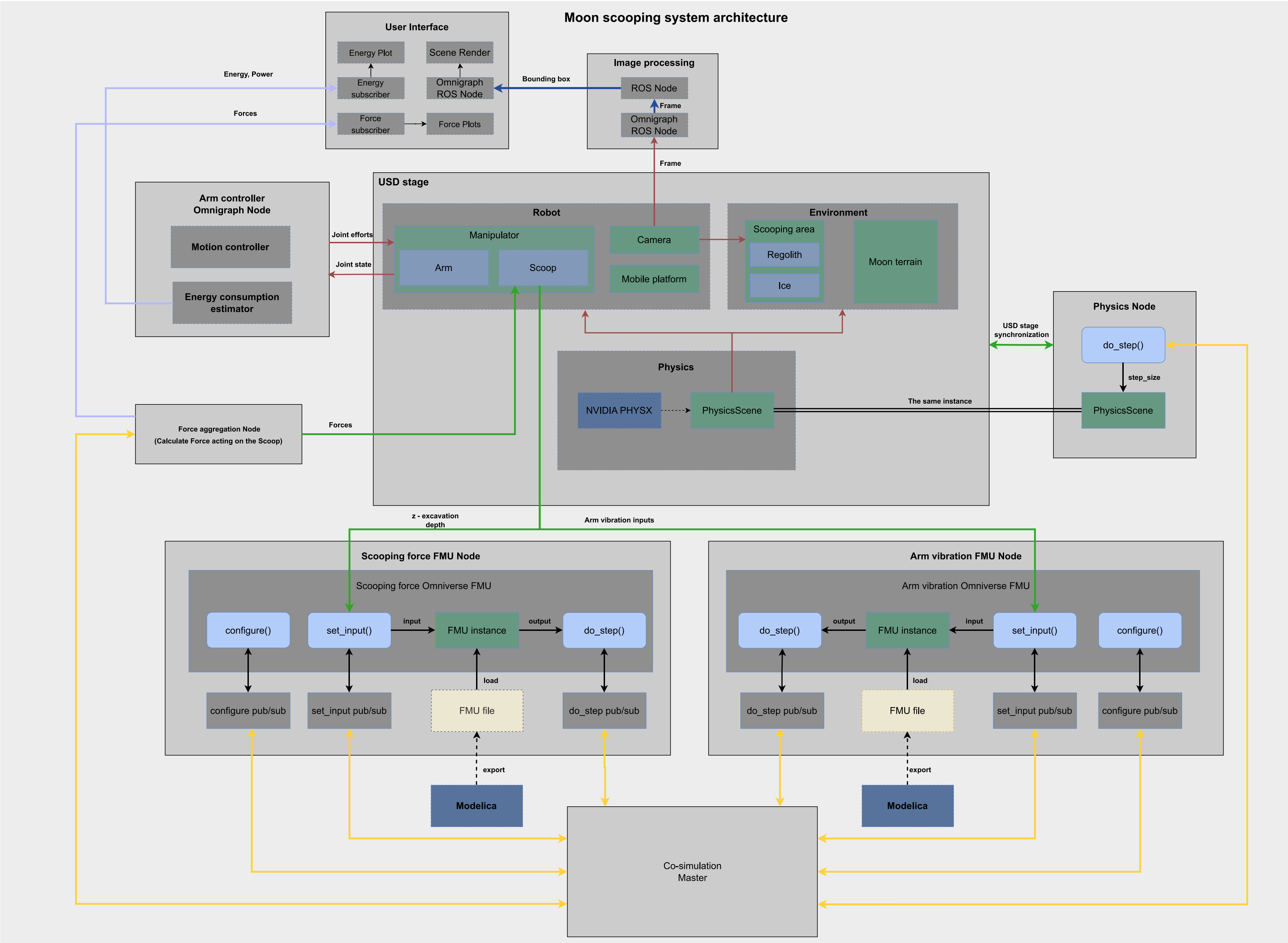
Challenge

- Excavation is essential for mining resources on the Moon
- So far, only small-scale scientific tests have been done
- Future missions need scalable, efficient solutions
- Lunar gravity must be factored into design

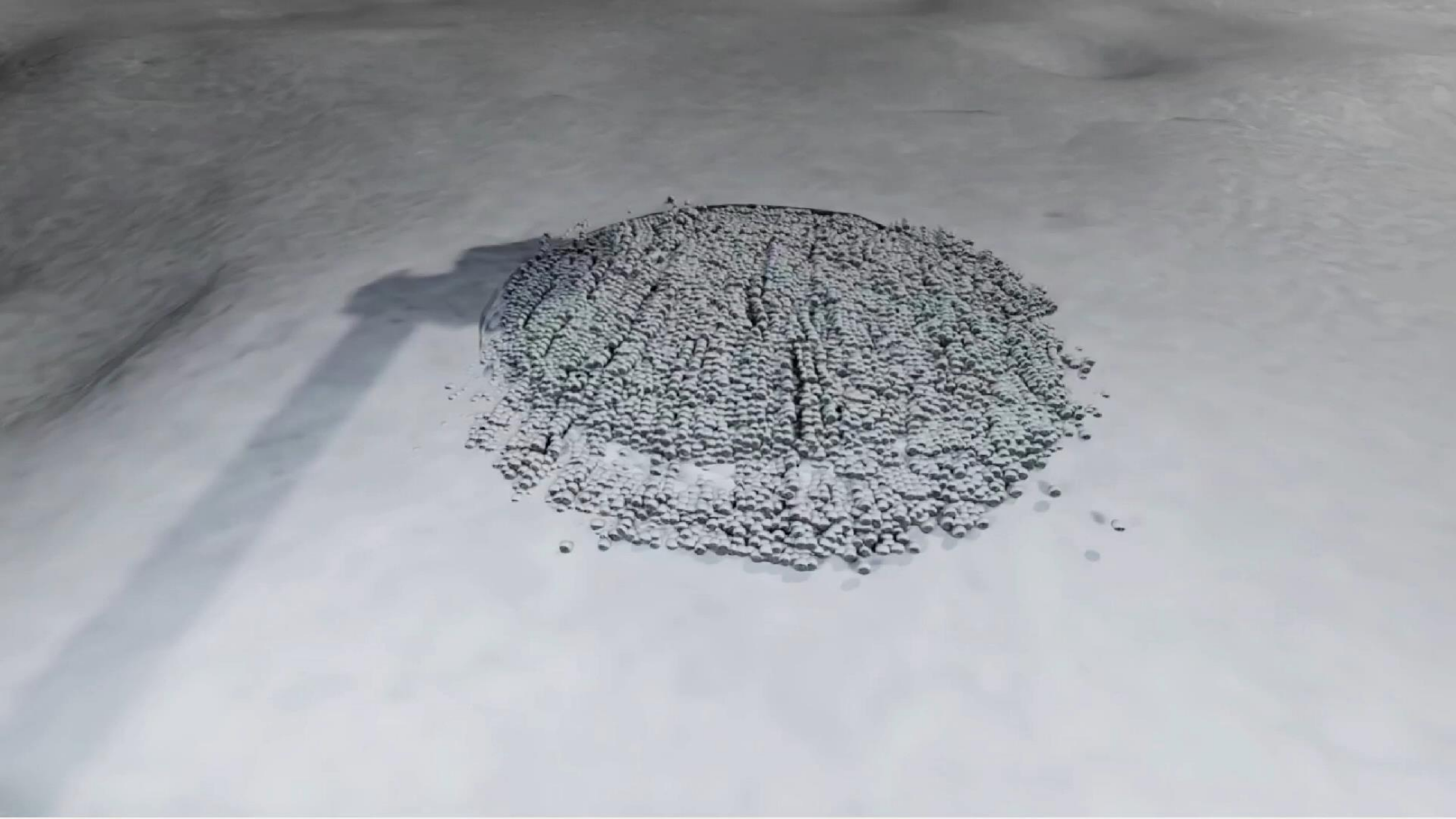
The Need
Advanced simulations to explore concepts and guide design



L-REX Co-simulation Architecture



- Live Session
- Omniverse Channels
- Omniverse Events
- ROS topics
- Internal Omniverse Communication
- Internal Python Communication



From Concept To Collaboration With NASA

DEC 22, 2023

EN

SOFTSERVE JOINS INTERNATIONAL TEAM TO DEVELOP NASA-FUNDED LUNAR LANDING AND LAUNCH PAD TECHNOLOGIES

Companies team up to develop Moon landing and launch pad technology with funding from NASA's STTR 2023 Program

AUSTIN, Texas (Dec. 22, 2023) – SoftServe, a premier IT consulting and digital services provider, today announced plans of joining an international coalition on a NASA-funded project to develop lunar technologies. The project comes after San Antonio-based Astroport Space Technologies won a NASA STTR 2023 Phase II

READ MORE

Co-simulation for Ground Vehicles Mobility

Integrated with NVIDIA Isaac Sim

Semi-Empirical Modeling for Planetary Mobility

Pioneered by M. G. Bekker

Established in the 1950s

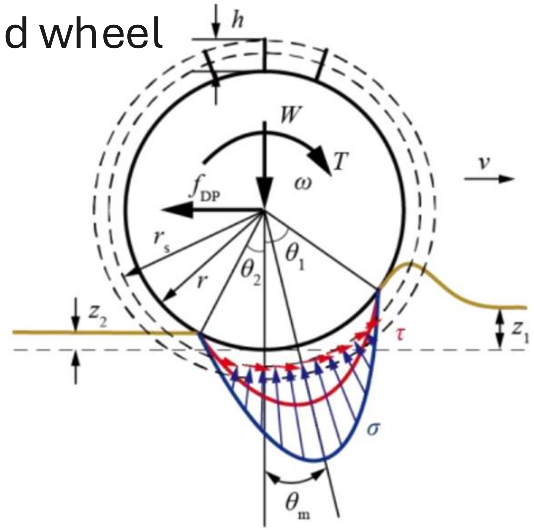
Extensive validation for terrestrial vehicles

Proven Space Heritage

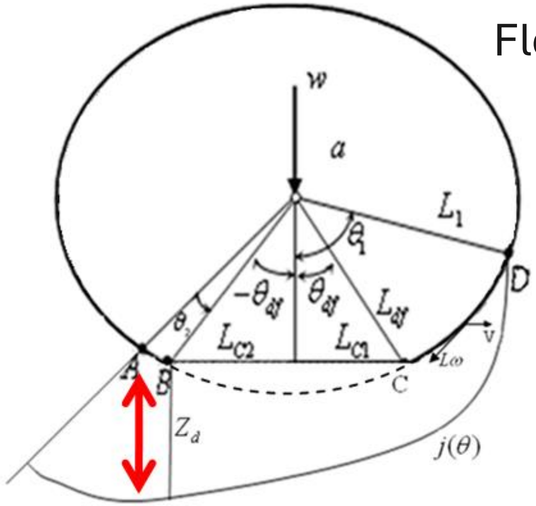
Lunar Rovers: Apollo LRV, Yutu

Mars Rovers: JPL Mars rovers, ExoMars, Zhurong

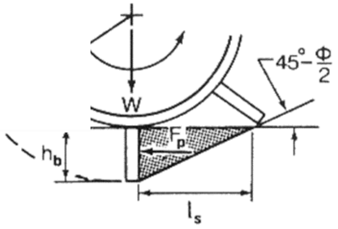
Rigid wheel



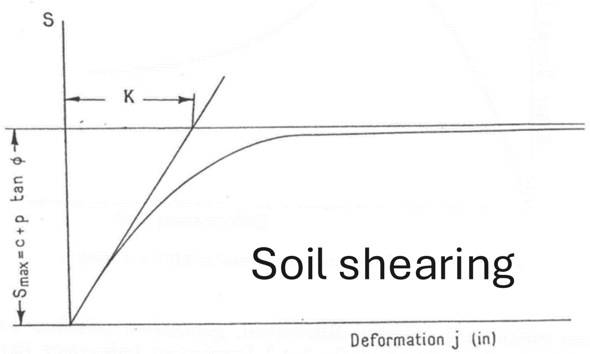
Flexible wheel



grouser

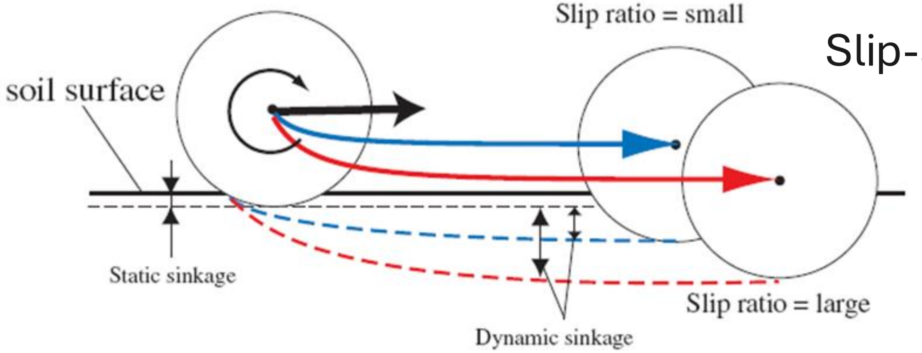


Terramechanics approach



Soil shearing

Slip-sinkage



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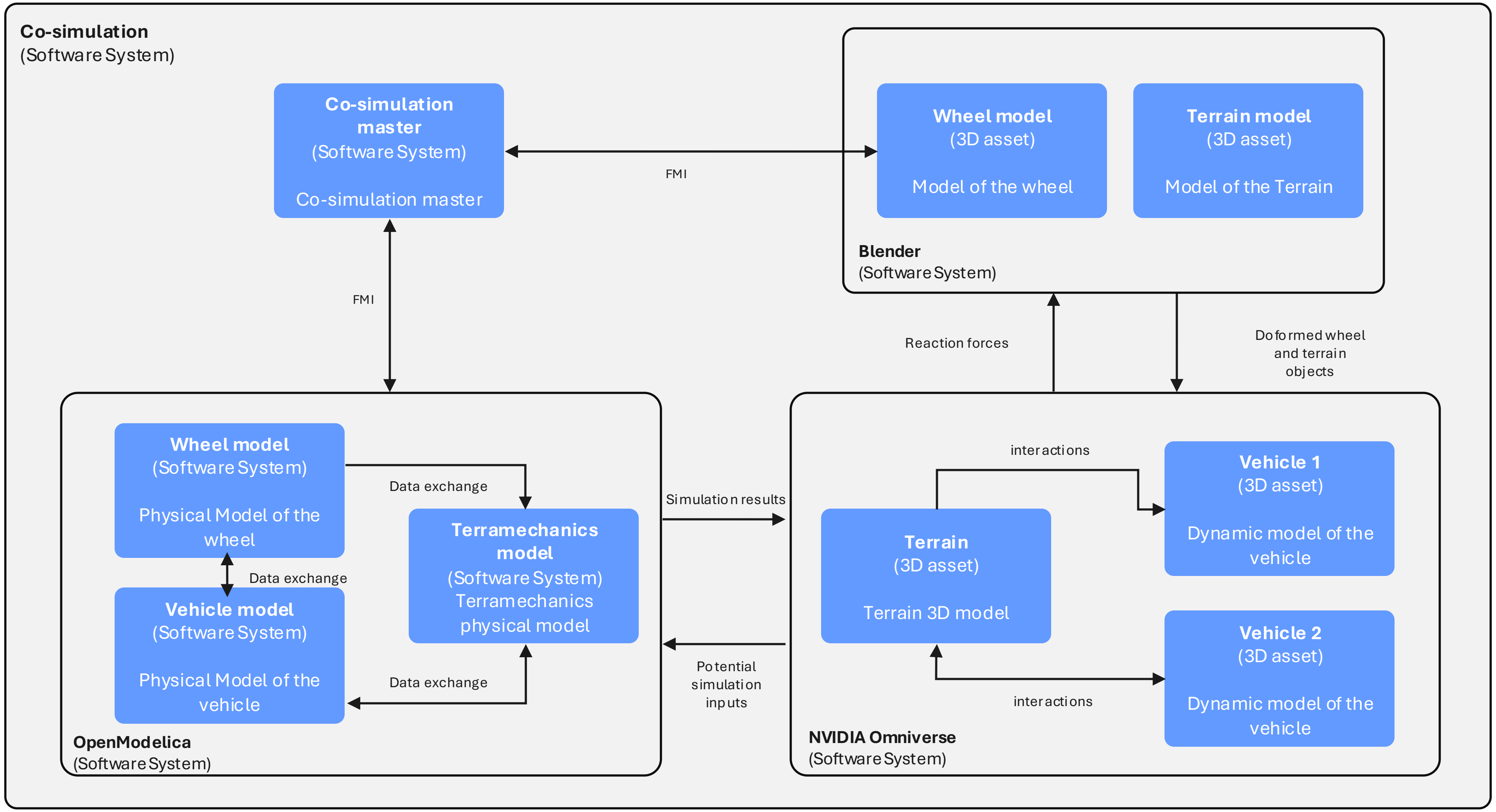
Co-simulation for Ground Vehicles Mobility

Integrated with NVIDIA Isaac Sim



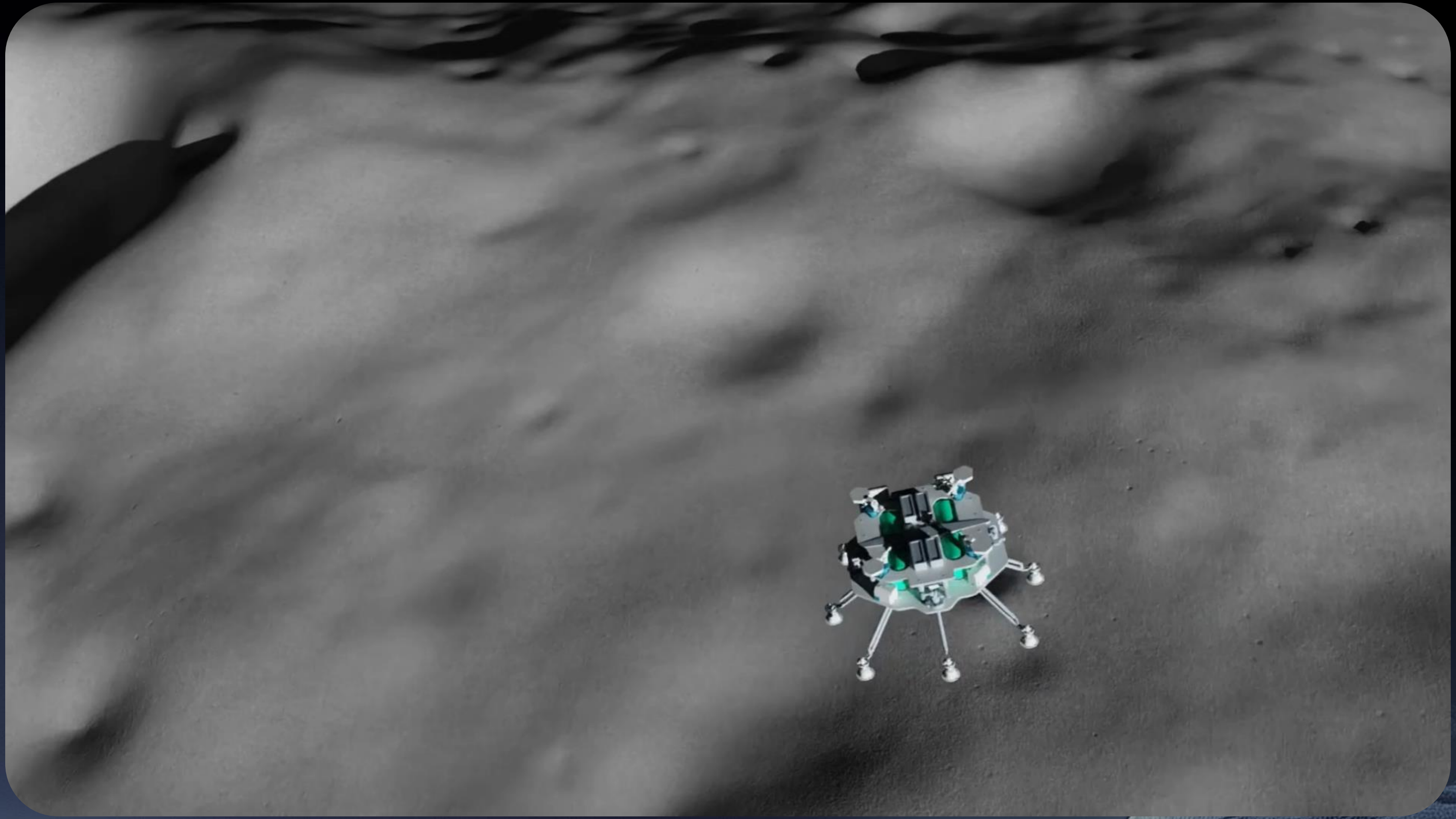
Co-simulation For Ground Vehicles Mobility

Integrated with NVIDIA Isaac Sim

Terramechanics Simulation

Progress Update

Multi-robot On The Moon



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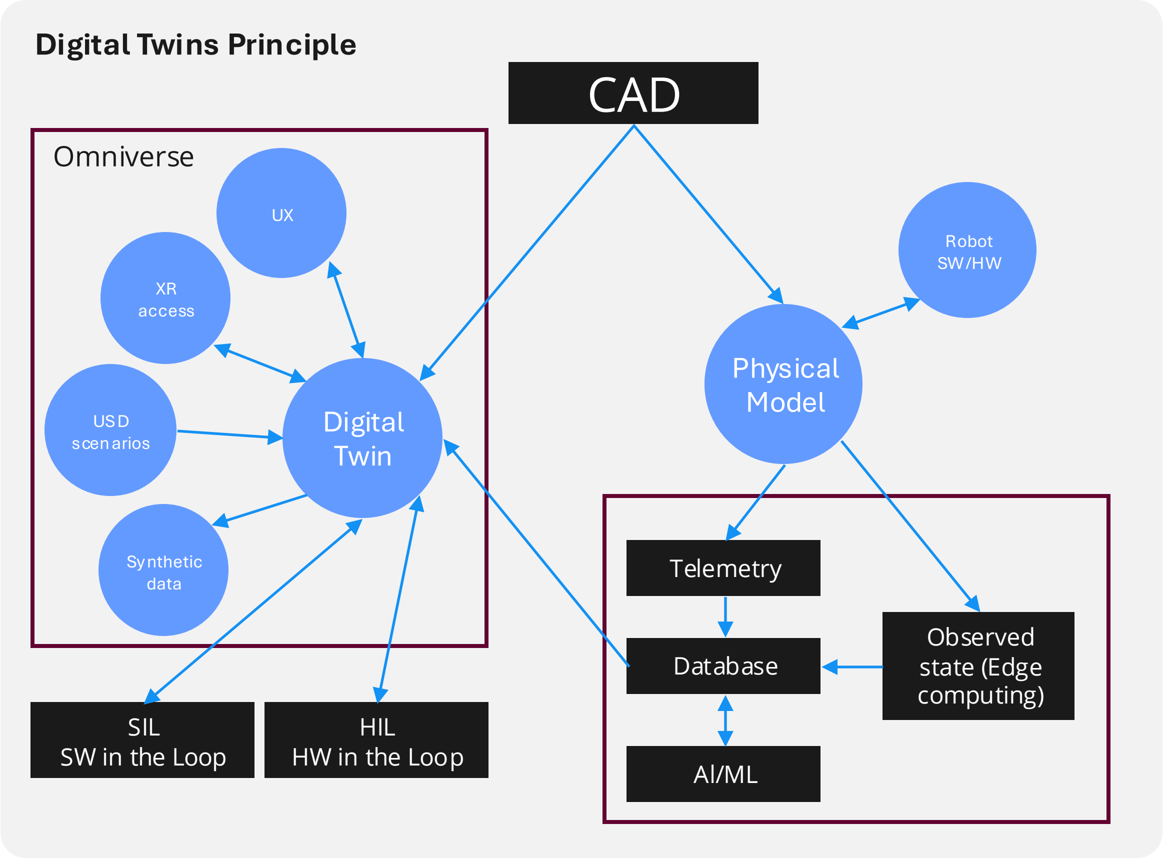
Digital Twins For Space Systems

Capabilities

- Simulate full system behavior with environment interaction (digital twinning)
- Model satellite formations, constellations, and clusters
- Include communications links and GNSS interactions (pointing & positioning)
- Perform virtual commissioning (VC) and software-in-the-loop (SIL) testing



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Optimal Control of Dynamical Systems

Capabilities

AI adapts goals to changing system states and environments
Handles uncertainties in real-time operations

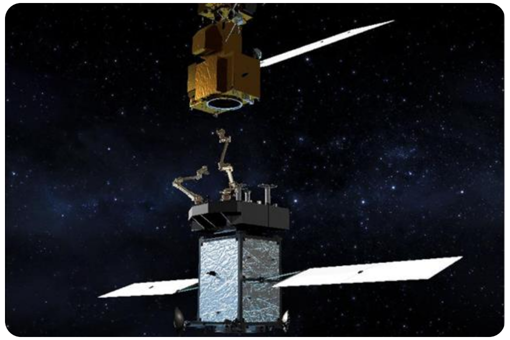
Use Cases

Proximity operations: rendezvous, capture, servicing, debris removal
Orbit and position control: satellite formations and constellations

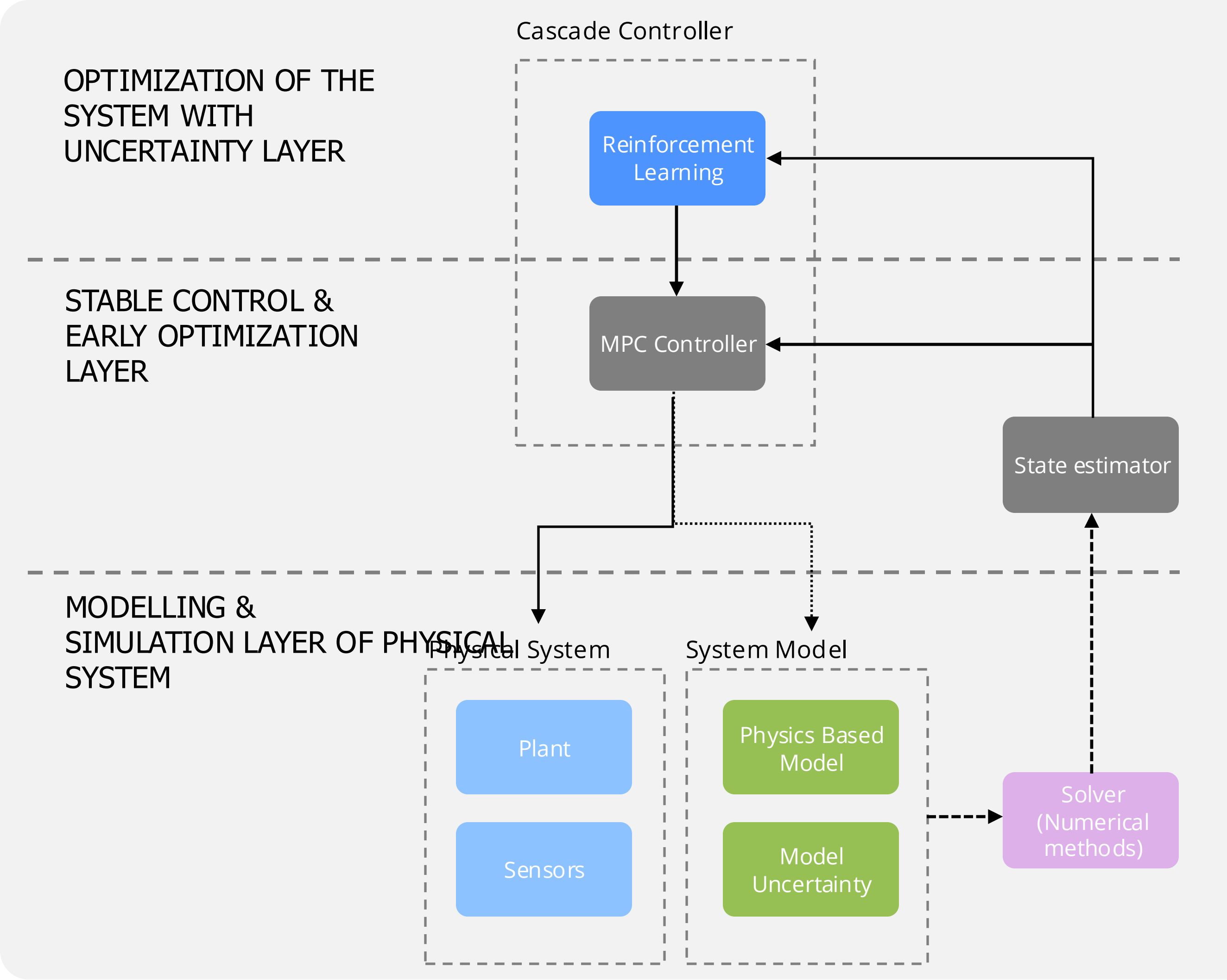
Technologies

Digital twins and physics-based simulations for control design

CloudCT Nanosat formation of S4 GmbH (Germany)



Satellite servicing concept (NASA)



Takeaways

SoftServe In Space & In The Lunar Economy

There's a lot happening in space — and the *Space Economy* is upon us

SoftServe's role: "simulation-first" + supporting system design and testing

NVIDIA Isaac Sim enables:
- Space-related simulations
- Digital twinning
- Physics-based modeling

Built on NVIDIA Omniverse™

...and we have a lot more on our space agenda!

LET'S TALK!

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THANK YOU!

Lutz Richter

Space Projects Consultant
Robotics & Advanced Automation,
SoftServe lrich@softserveinc.com

ANY QUESTIONS?
LET'S TALK


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FOR THE FUTURE

Backup

Journey from Perception AI to Physical AI with SoftServe

NVIDIA full stack first & partner-orchestrated

Business-led, value-driven operating model to enable scaling

AlexNet

2012

First widely recognized application of deep convolutional networks

Perception AI

Speech recognition, deep RecSys, medical imaging

Generative AI

Digital marketing, content creation

- SoftServe Gen AI Solutions Using NVIDIA AI Blueprints
- Visual Search & Summarization (VSS)

Agentic AI

Coding assistant, customer service, patient care

- Agentic QA Agents

Physical AI

Self-driving cars, general robotics

- Cosmos EA
- Virtual Factory Integration
- SoftServe Warehouse Sim