IM-1 PRESS KIT

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INTRODUCTION

FROM A NAPKIN TO THE MOON

THE INTUITIVE MACHINES STORY

About Intuitive Machines

Intuitive Machines, a leading space exploration and infrastructure company, was founded in 2013. In 2012, Co-founder and CEO Steve Altemus found inspiration during a casual dinner conversation with Co-founder Dr. Kam Ghaffarian, a visionary entrepreneur and engineer. It was during that dinner in Washington, D.C., that Altemus jotted down the initial blueprint for Intuitive Machines on a napkin. This idea sparked the innovation that would drive the company's mission to create cutting-edge solutions to solve some of humanity's most formidable challenges.

In 2013, the core team, including Co-founder Dr. Tim Crain, stepped out of the gates of NASA's Johnson Space Center to take a shot at changing the world.

In 2018, the United States declared the Moon of strategic interest and refocused NASA on returning to the Moon sustainably under the agency's Artemis program. The following year, NASA awarded Intuitive Machines its first task order to land a suite of payloads on the surface of the Moon. Over the next four years, Intuitive Machines built an entire space program, including its Nova-C lunar lander, mission control, and global Lunar Telemetry and Tracking Network (LTN) capable of spacecraft data transmission at lunar distance. With these assets complete, Intuitive Machines is prepared to conduct its first mission to the Moon, IM-1.

From its humble beginnings on a napkin, Intuitive Machines has evolved into a diversified space exploration and infrastructure company prepared to pioneer the commercial landscape of space - with a North Star of landing on the Moon.

RESOURCES AND EVENTS

News Releases and Features

Mission news, updates, and feature stories about Intuitive Machines and the IM-1 mission are available below:
Intuitive Machines News Releases
IM-1 Mission Stream and Information

The latest information about launch and landing activities can be found on the Intuitive Machines IM-1 landing page.

Multimedia Resources

Intuitive Machines IM-1 mission image and video galleries include:
Intuitive Machines Flickr Gallery
IM-1 Mission Video Gallery

Web Resources

Official Intuitive Machines Website
Intuitive Machines Leadership
NASA Commercial Lunar Payload Services (CLPS)

Media Events

The most up-to-date information about IM-1 media events and where they may be viewed can be found on the press section of the IM-1 landing page.

How to Watch

NASA, SpaceX and Intuitive Machines will host a live launch stream which will be available on NASA TV and the IM-1 landing page, NASA TV, and spaceX.com.
Intuitive Machines will host landing live-stream on NASA TV and on the IM-1 landing page.

IM-1 MISSION OVERVIEW

IM-1 SUMMARY

INTUITIVE MACHINES IS ATTEMPTING TO BECOME ONE OF THE FIRST COMMERCIAL COMPANIES TO LAND SOFTLY ON THE LUNAR SURFACE.

IM-1 is a trailblazing mission aimed at creating a commercial lunar economy, delivering commercial payloads and NASA science and technology payloads that will pave the way for a sustainable human presence on and around the Moon. The mission aims to be the first U.S. vehicle to softly land on the lunar surface since Apollo 17 in 1972.

Intuitive Machines selected SpaceX to launch the Company's Nova-C class lunar lander, named Odysseus, on a SpaceX Falcon 9 rocket from NASA Kennedy Space Center's Pad 39A. After launch, Odysseus is planned to separate from the Falcon 9 rocket on a direct trajectory to the Moon.

Intuitive Machines flight controllers working from Nova Control in Houston, Texas, expect Odysseus to land on the Moon approximately nine days after liftoff.

After touchdown, Intuitive Machines and its customers expect to operate payloads on the lunar surface for roughly seven days before the lunar night sets on the south pole of the Moon, rendering Odysseus inoperable.

INTUITIVE MACHINES

WHY WE ARE GOING

IM-1

The IM-1 mission, orchestrated by Intuitive Machines, marks a monumental step in lunar exploration, rekindling humanity's quest to the Moon. This mission signifies not only a return to the lunar surface after a hiatus of several decades but also a bold leap into a new era of commercial lunar science and exploration.

At the heart of the IM-1 mission is the Nova-C lunar lander, designed and constructed by Intuitive Machines. The lander is equipped with state-of-the-art technology, including a propulsion system powered by an environmentally friendly mix of liquid oxygen and liquid methane. This mission's primary objective is to deliver a variety of payloads to the Moon's south pole region, a part of the Moon that remains unexplored. These payloads include scientific instruments and technology demonstrations that aim to pave the way for future human and robotic exploration of the Moon.

The significance of the IM-1 mission extends beyond the mere act of landing on the lunar surface. It represents a pivotal moment in the ongoing narrative of space exploration, where private enterprises play an increasingly vital role. Through NASA's Commercial Lunar Payload Services (CLPS) initiative, the IM-1 mission is part of a broader strategy to foster a sustainable presence on the Moon, facilitating scientific discovery, resource utilization, and the development of lunar infrastructure. The knowledge and experience gained from this mission will be invaluable in shaping future missions to the Moon and beyond.

Moreover, the IM-1 mission's success will lay the groundwork for a burgeoning lunar economy, opening new possibilities for research, commerce, and exploration. By advancing our capabilities to operate on the lunar surface, the mission sets the stage for more ambitious endeavors, including the establishment of lunar bases and the exploration of potential resources. The data and insights gleaned from the IM-1 mission will potentially address the challenges of living and working on the Moon, thus furthering humanity's dream of becoming a multi-planetary species.

INTUITIVE MACHINES & NASA'S COMMERCIAL LUNAR PAYLOAD SERVICES (CLPS)

Intuitive Machines is a leading vendor in NASA's Commercial Lunar Payload Services (CLPS) initiative.

CLPS is a part of NASA's lunar exploration efforts. The science and technology payloads sent to the Moon's surface as part of Intuitive Machines' IM-1 mission, are intended to help lay the foundation for human missions and a sustainable presence on the lunar surface.

With CLPS as a springboard for innovation, Intuitive Machines designed and developed a complete lunar program to help support NASA's Artemis campaign and the commercial development of the Moon.

COMMERCIAL LUNAR DATA NETWORK

LUNAR DATA NETWORK (LDN): A PRIVATE AND SECURE NETWORK TO SUPPORT LUNAR MISSIONS

Offered commercially, LDN supports line-of-sight and data relay services for spacecraft in cislunar space and systems on the lunar surface. The secure interoperable LDN comprises of a mission control center and global ground stations with Intuitive Machines base-band units installed at each location.

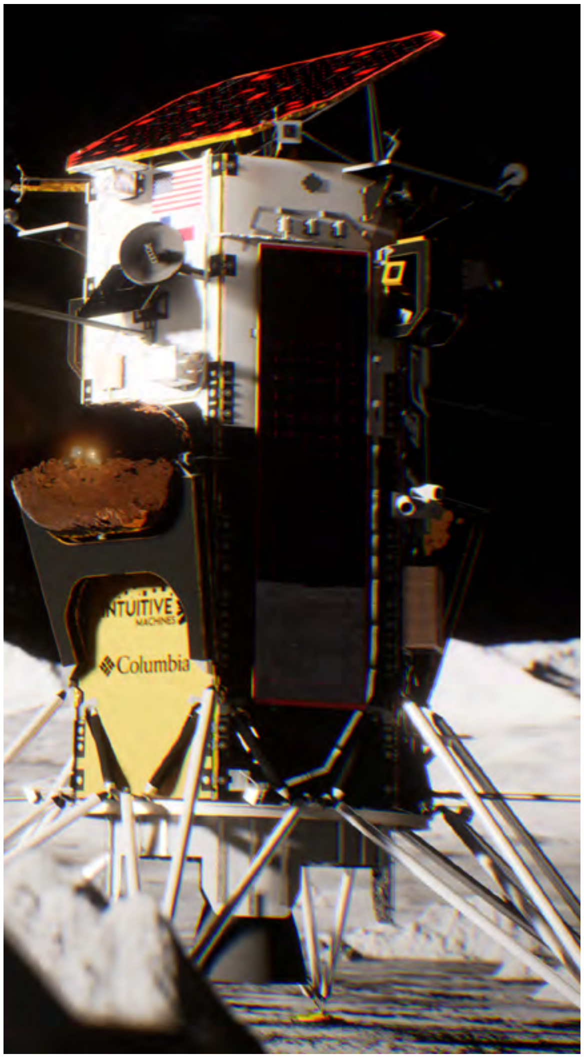
Nova Control is the nerve center of Intuitive Machines' lunar mission operations in Houston, Texas. The operations center hosts mission controllers in a collaborative circular environment with access to mission-critical and support software, including VoIP voice system. Nova Control is commercially offered, and the mission-critical command and control software, Nova Core, is developed and sustained in-house with contingency operations achieved in partnership with Fugro SpAARC in Western Australia.

Intuitive Machines has long-term agreements with ground stations across the globe that comprise its Lunar Tracking, Telemetry, and Command Network (LTN), which support S-band, X-band, and Ka-band uplink and downlink.

In December 2022, Intuitive Machines validated its LDN by successfully tracking NASA's Artemis I mission as the spacecraft reached its farthest distance from Earth.

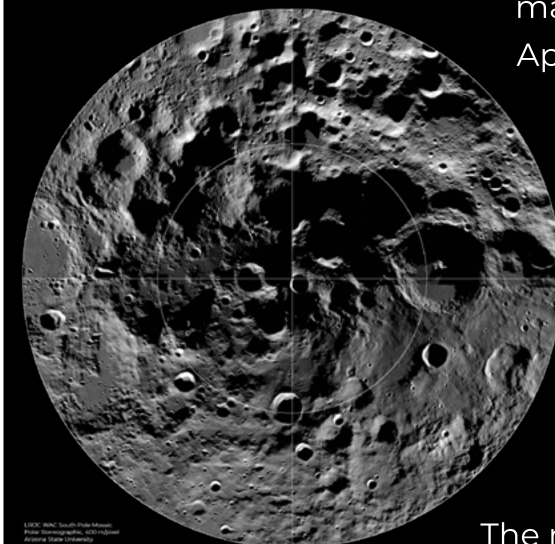
MURRIYANG, CSIRO'S 64M PARKES RADIO TELESCOPE

LANDING SITE



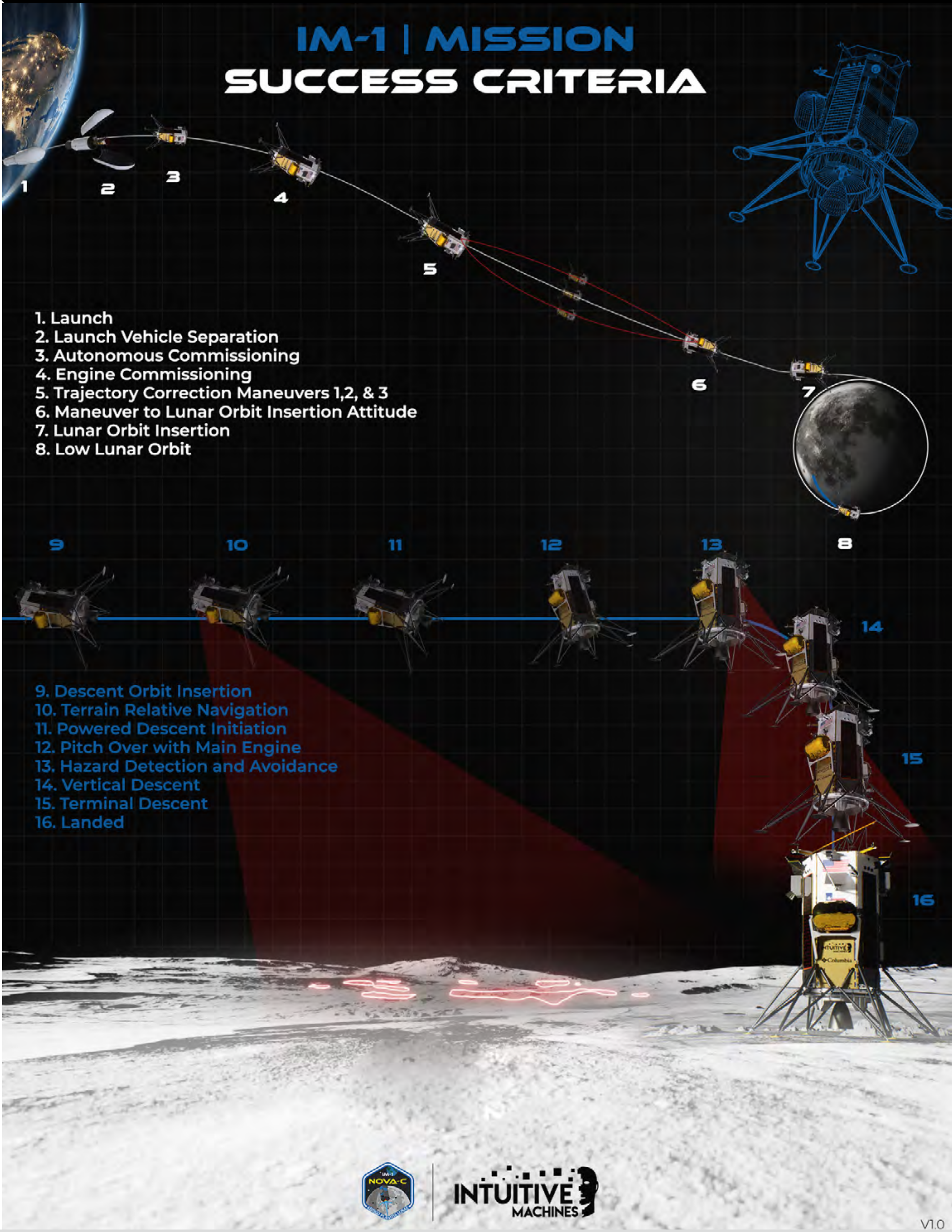
Malapert A is a satellite crater to Malapert, a 69 km crater in the Moon's south pole region.

Named after Charles Malapert, a 17th century Belgian astronomer, the area around the landing site is believed to be made of lunar highland material, similar to Apollo 16's landing site.



The IM-1 landing site is about 300 km from the Moon's south pole.

The nearby Malapert Massif is one of the 13 candidate regions being considered for NASA's Artemis III mission.

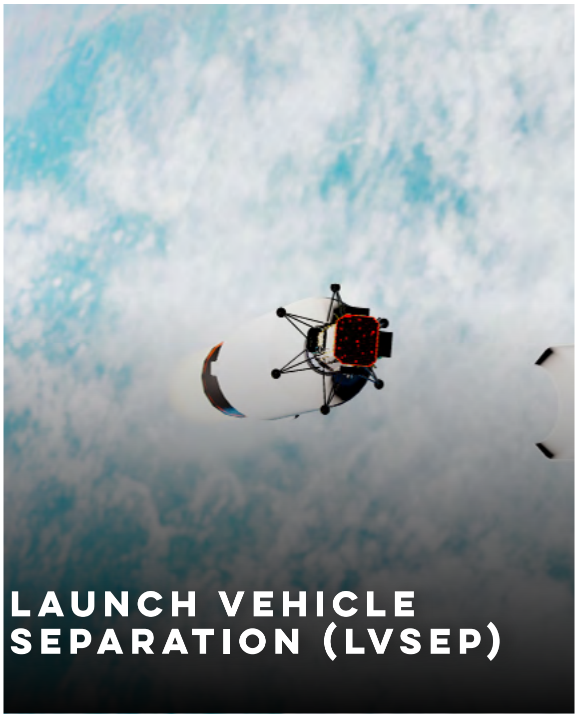

IM-1 | MISSION
SUCCESS CRITERIA
1
2
3
4
5
6
7
8
1. Launch
2. Launch Vehicle Separation
3. Autonomous Commissioning
4. Engine Commissioning
5. Trajectory Correction Maneuvers 1,2, & 3
6. Maneuver to Lunar Orbit Insertion Attitude
7. Lunar Orbit Insertion
8. Low Lunar Orbit
9
10
11
12
13
14
15
16
9. Descent Orbit Insertion
10. Terrain Relative Navigation
11. Powered Descent Initiation
12. Pitch Over with Main Engine
13. Hazard Detection and Avoidance
14. Vertical Descent
15. Terminal Descent
16. Landed
IM-1 NOVA-C
INTUITIVE MACHINES
V1.0

IM-1

MISSION MANEUVER OVERVIEW

LAUNCH

Intuitive Machines selected SpaceX to launch the Company’s Nova-C class lunar lander, named Odysseus, on a SpaceX Falcon 9 rocket from Launch Complex 39A at NASA’s Kennedy Space Center in Florida.



LAUNCH VEHICLE SEPARATION (LVSEP)

Shortly after launch, a spring force will gently push Odysseus away from the launch vehicle’s second stage, allowing the lunar lander to deploy and drift away toward the Moon. Odysseus is in a standby state before separation. Break wires connected to the launch vehicle let the Nova-C spacecraft know it has deployed, and a timer starts on the lander to activate its primary systems. After completing the separation timing interval, Odysseus powers on, including Guidance Navigation and Control (GNC), Automated Flight Management (AFM) software, radios, and thermal control.

*Mission Maneuvers are Subject to Change

MISSION MANEUVER OVERVIEW

Intuitive Machines expects to commission Odysseus several minutes after LVSEP autonomously. During autonomous commissioning, the lander's GNC activates the cold-gas helium Reaction Control System (RCS) to control the vehicle attitude.

At this point, Odysseus does not know where it's pointed, but it can stop its spin motion, much like a person spinning in a chair with closed eyes can control the spin without knowing where it stops.

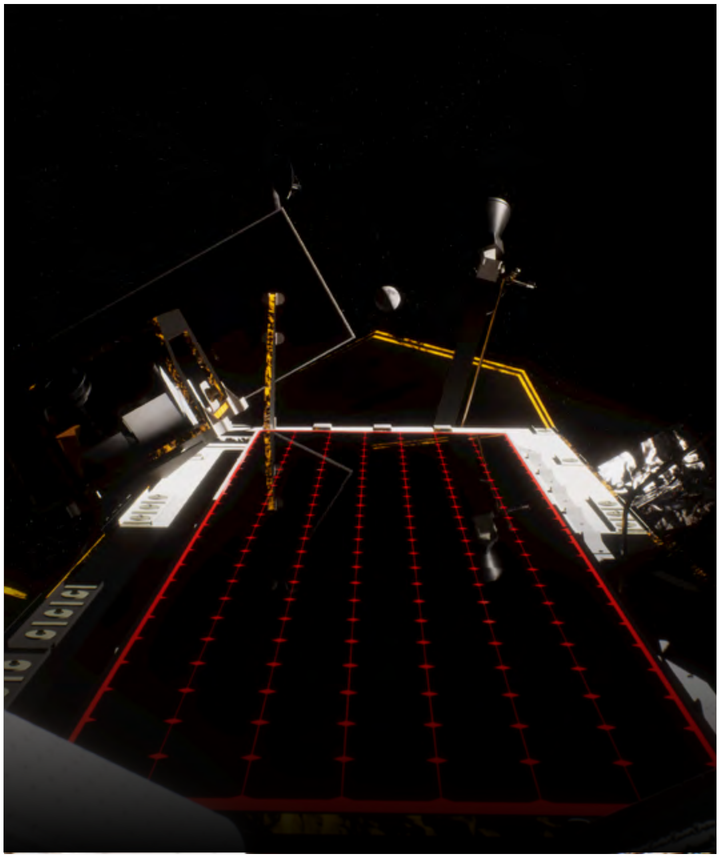
After controlling the spin rate, special cameras known as star trackers autonomously match images of the distant star field and provide Odysseus with its orientation. Software onboard takes the star tracker measurements and processes them through an algorithm known as the Kalman filter to correct the onboard orientation, known as attitude, and then estimates and rejects bad measurements.

Once the GNC system has autonomously determined its attitude relative to the star field, it uses a reference position from the nominal launch vector to determine the approximate location of the sun. GNC then commands RCS jets to maneuver the lander's top deck toward the sun with a slight angle to illuminate the top deck and side solar arrays to generate maximum power.

Odysseus holds this approximate attitude within +/- 15 degrees for the entire mission other than when flight controllers in Nova Control are executing maneuvers or pointing the lunar lander's High Gain Antenna (HGA) used for communications back to Earth.

When Odysseus' top deck is pointed toward the sun, this is known as max power attitude, which also helps flight controllers in Houston, Texas, manage the lander's thermal state on the vehicle by keeping other systems in the shade of the top deck and side deck solar arrays. Each step in the commissioning process is expected to happen autonomously because flight controllers in Houston do not have communications with Odysseus yet.

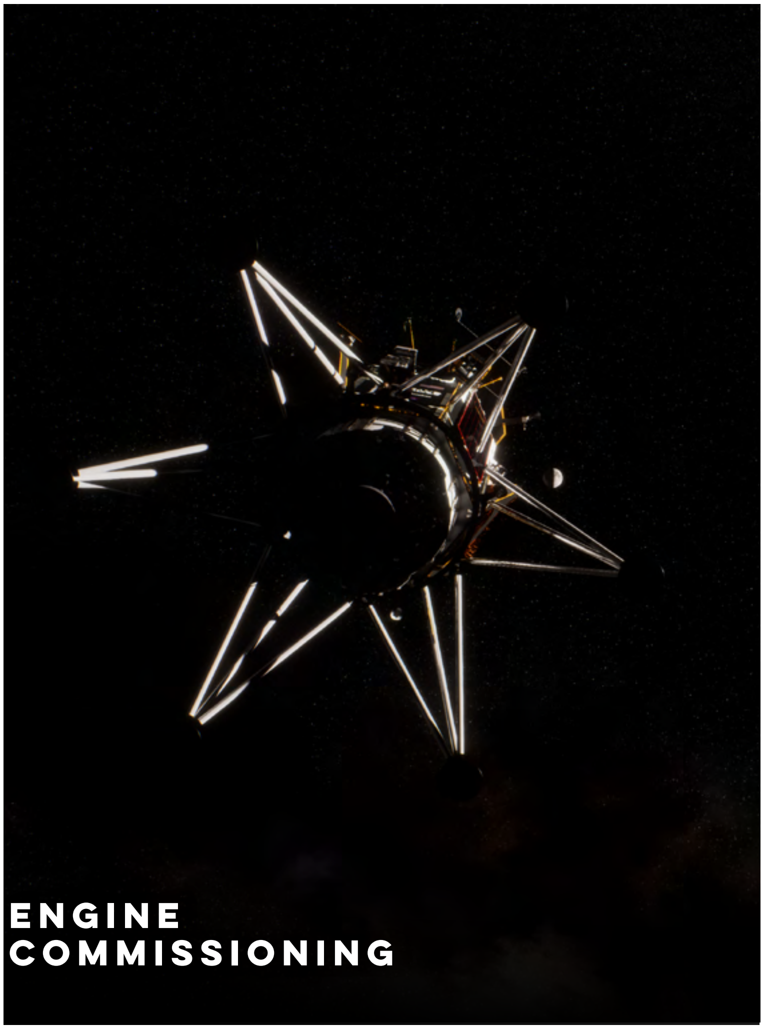
When autonomous commissioning is complete and max power attitude is established, Odysseus turns on its communication radios and makes first contact with flight controllers in Nova Control.



*Mission Maneuvers are Subject to Change

IM-1

MISSION MANEUVER OVERVIEW



After autonomous commissioning, flight controllers in Nova Control prepare for the engine commissioning maneuver using Odysseus' state-of-the-art cryogenic propulsion system. The engine commissioning maneuver allows flight controllers to verify engine performance and adjust the lander's first trajectory.

Odysseus is moving on a Trans-Lunar Orbit (TLO) after LVSEP on its way to the Moon before Engine Commissioning. Flight controllers on the trajectory team (TRAJ) use the signal from the lander's communication systems to perform Orbit Determination (OD) and fire arcs of this signal data to update how fast it is moving. Minor corrections are expected to stay on course, like a car driver making minor adjustments with the steering wheel along a straight stretch of road.

Intuitive Machines' Flight Dynamics Officer (FDO) uses this update to calculate a direction to execute the engine Commissioning Maneuver (CM) for the best improvement in Odysseus' trajectory to intercept the Moon.

With the CM direction set by FDO, Intuitive Machines' Flight Manager (FM) and Communications Officer (COMM) command the vehicle to rotate from max power attitude to burn attitude. Now, CM transitions control to Intuitive Machines' Propulsion Operations (PROP) lead to begin the main engine burn.

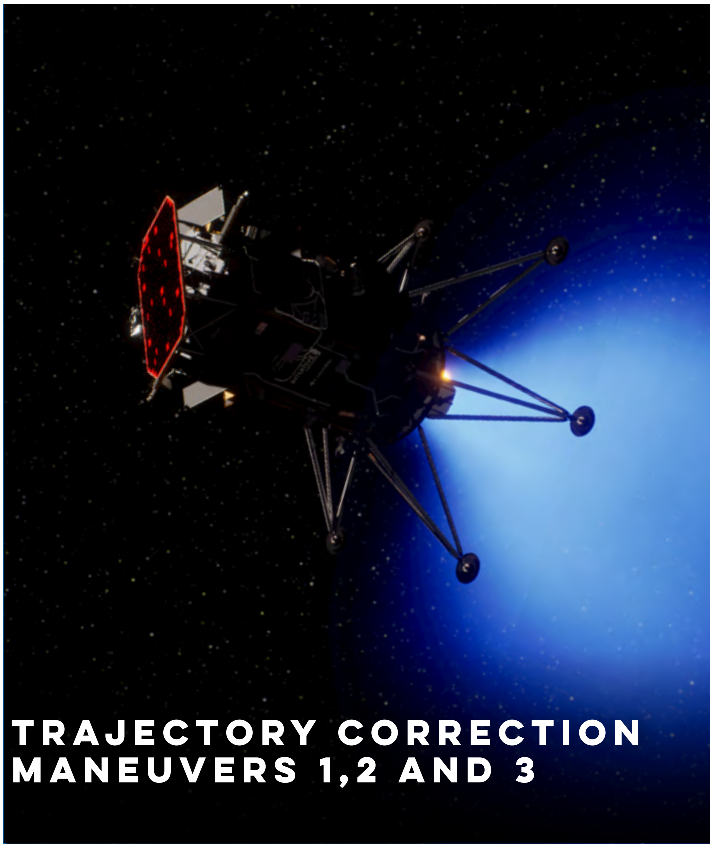
There are multiple steps to performing a main engine burn. The first is to flow cryogenic methane and oxygen down the lander's feed lines to the engine to condition the propulsion system temperature; we call this chillin the engine. PROP monitors several automated valve and temperature readings in this process to ensure everything is progressing within the expected parameter ranges.

The onboard AFM is monitoring the Time of Ignition (TIG) for the CM to begin. A few seconds before TIG, the RCS system fires jets to settle their tanks' liquid methane and oxygen. Then, the main engine igniter comes on, much like a pilot light in a gas oven, to ignite methane and oxygen, which have been mixed in the combustion chamber by a carefully orchestrated opening of main throttle valves. The engine start-up sequence is something that Intuitive Machines has tested thousands of times to validate safety and reliability.

During CM, the vehicle holds a constant attitude by adjusting the angles of the main engine inside a two-axis gimbal ring designed by the Intuitive Machines team. The automated CM sequence also throttles the main engine to give the PROP team data to make necessary adjustments across the engine's power range. At the same time, Odysseus continues to coast toward the Moon.

*Mission Maneuvers are Subject to Change

MISSION MANEUVER OVERVIEW



TRAJECTORY CORRECTION MANEUVERS 1,2 AND 3

After CM, TRAJ collects data from another OD update. FDO evaluates this update and calculates how far Odysseus might be from hitting its orbit target around the Moon. FDO uses a particular coordinate system called the B-Plane, which is the mission design equivalent of the square on the backboard in basketball. If a basketball player hits the backboard square with a shot, the ball is likelier to go in the hoop. Similarly, if Odysseus hits its target on the B-Plane, it is in the right spot to be captured into lunar orbit.

The expected mission scenario is that each Trajectory Correction Maneuver (TCM) will be smaller than the previous one as flight controllers dial in the lander's B-Plane target. TCM 3 is the most critical maneuver because it is the last chance flight controllers in Houston have to correct Odysseus' trajectory before it is captured into lunar orbit.

For each TCM, FDO evaluates the maneuver size needed to keep the B-Plane target in the lander's path. If the TCM is less than the ability of Odysseus' main engine to execute, the flight controllers may choose not to perform that TCM and make any corrections during the next opportunity.

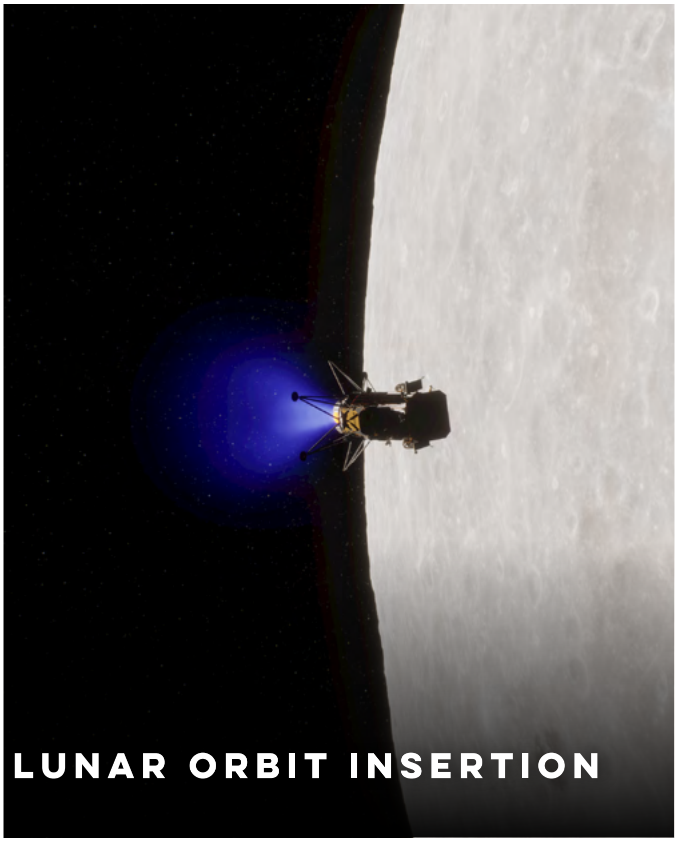
The Nova-C class lunar lander's three TCM burns are executed at maximum throttle, where the engine is most efficient. After each TCM, Intuitive Machines flight controllers point the lander's HGA back to Earth for communication to Nova Control.

Following TCM 3, the TRAJ team collaborates with FDO to finalize the OD solution crucial for updating the Lunar Orbit Insertion (LOI) maneuver. Concurrently, Odysseus' top deck maximizes solar energy capture post-TCM 3, adopting the maximum power attitude. As LOI approaches, Odysseus uses its RCS to orient retrograde, directing the engine towards the Moon for optimal positioning ahead of the maneuver.

MANEUVER TO LUNAR ORBIT INSERTION ATTITUDE

*Mission Maneuvers are Subject to Change

MISSION MANEUVER OVERVIEW



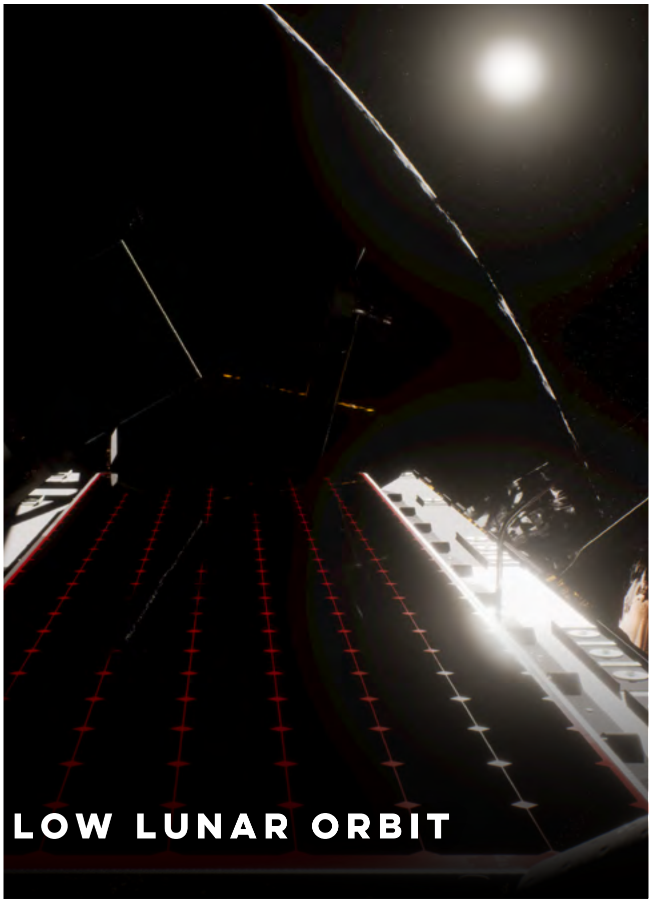
After flight controllers load the final LOI maneuver solution on Odysseus, Intuitive Machines expects about four hours of watching systems prepare for this maneuver. For IM-1, LOI is performed in the blind on the far side of the Moon. Flight controllers are not receiving real-time updates because there is no line-of-sight communication back to Earth.

The Nova Control team counts down to LOI TIG and waits for the lander to perform its largest maneuver, between 800 and 900 meters per second, to capture into a 100 km circular Low Lunar Orbit (LLO). This maneuver is approximately one-third of the total capability of Odysseus' propulsion system.

After a successful LOI, the Nova Control team starts a cadence of activities to check the lander's status and its systems in LLO to prepare for landing. This includes calibrating Odysseus' navigation optical cameras for lunar illumination conditions.

For each lunar orbit, Intuitive Machines expects to have about 75 minutes of communication followed by 45 minutes where the Moon blocks Odysseus' direct line-of-sight radio link between the lander and Intuitive Machines' ground stations. When flight controllers lose communications and are in a communications blackout, we call it Loss of Signal (LOS). When flight controllers regain communication and are within line-of-sight, we call it Acquisition of Signal (AOS). Odysseus will orbit the Moon approximately 12 times before descending to the surface.

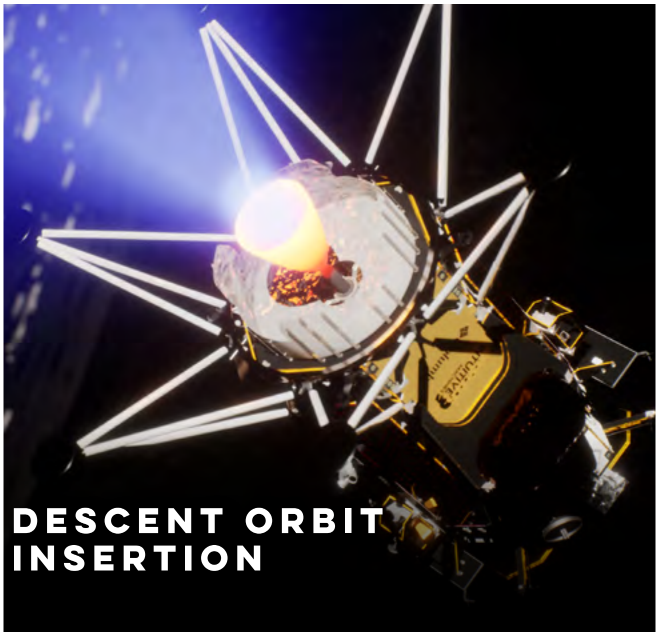
For Intuitive Machines, LLO environment is more complex than the deep space environment Odysseus experienced during transit. The Moon's harsh environments are actively at play. When the lander is on the sunward side of the orbit, the sun heats the lander on one side, but the Moon also bakes the other side of the spacecraft with reflected infrared radiation, so Odysseus is very warm. Then, the lander passes into the lunar shadow, and the vehicle plunges into a deep cold regime and requires heater power drawn from batteries to keep systems warm.



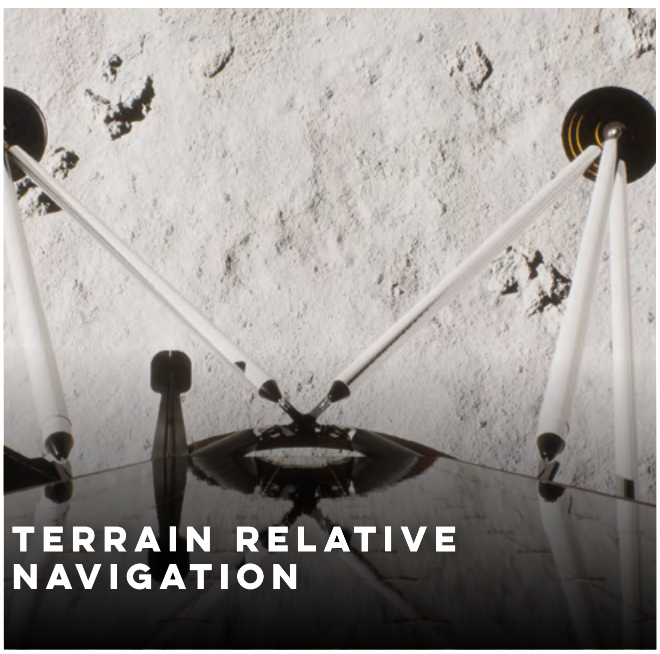
*Mission Maneuvers are Subject to Change

IM-1

MISSION MANEUVER OVERVIEW



Descent Orbit Insertion (DOI) is a small maneuver that usually happens on the far side of the Moon. The main engine fires to slow the lander so that its minimum altitude drops from 100 km to about 10 km near the landing site. The low point of an orbit around the Moon is called perilune, while the high part is apolune. In orbit, Odysseus travels faster near the peri condition and slower at the apo state. This effect is an exchange of potential energy like what people experience riding a bike through hills, coasting fast at the low points and slower at the peaks. Once DOI occurs, Odysseus is completely autonomous. The lander is expected to coast for approximately one hour after DOI; then, the GNC system will activate the main engine for Powered Descent Initiation (PDI).



Terrain Relative Navigation (TRN) cameras and lasers on the lander's downward side feed information to the navigation algorithms, which provide guidance and control. This portion may sound complicated, but it's something humans do each time they walk, ride a bike, or drive a car. Sensors are like human eyes collecting position, velocity, and orientation data. Navigation is a brain processing this information to determine where and how you move. Guidance is similar to a human brain determining, if I am here, moving in this direction, what do I need to do to get where I want to be? The answer could be to turn left or speed up. Control is the equivalent of turning the steering wheel or stepping on the accelerator to improve the guidance command. Human eyes act as sensors, seeing how things change, and the complete cycle repeats.

Odysseus must reduce its velocity by approximately 1,800 meters per second to land softly on the surface of the Moon. Some lander designs have propulsion systems with multiple jets that fire on and off during descent to achieve this; however, Nova-C has an engine designed to continuously burn and throttle from PDI until touchdown. This approach is similar to what the Apollo descent module did.

When the lander engine comes on at PDI, it is initially in a hard braking phase. The lander stays in the braking phase until approximately 2 km from the landing site.

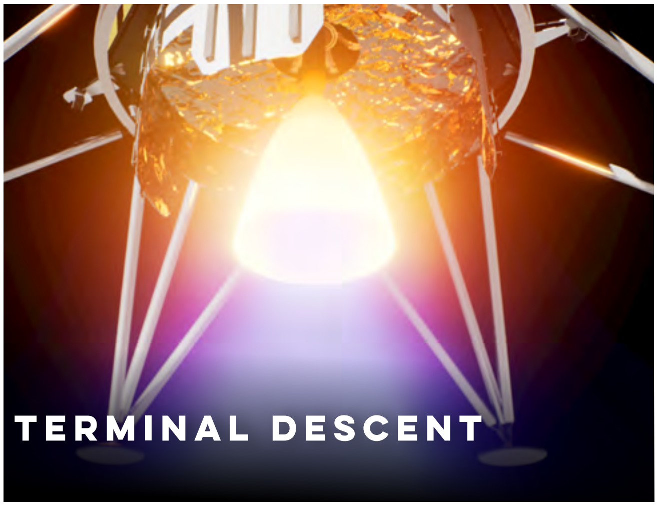
*Mission Maneuvers are Subject to Change

MISSION MANEUVER OVERVIEW

At the end of PDI, Nova-C pitches over using it's main engine. Now, Odysseus is generally upright, with the Hazard Relative Navigation (HRN) sensors facing forward in the area where the lander intends to touch down.

Intuitive Machines designed Odysseus' trajectory to fly to the Intended Landing Site (ILS) on the Moon. Once the Nova-C class lunar lander is getting closer to its ILS, the onboard software selects a safe Designated Landing Site (DLS) with the slightest slope, free from hazards, with the range of the lander.
Odysseus' systems are intended to match lunar gravity to fly toward the DLS. During this time, the main engine is continually throttling down, lowering the engine power to compensate for the lander getting lighter and lighter with spend propellants spent leaving the spacecraft's mass.

Odysseus' GNC system flies the lander to a point approximately 30 km above the DLS, and the lander goes into a vertical descent at three meters per second. Then, the lander brakes to a one-meter-per-second descent rate 10 meters above the surface, preparing for terminal descent and landing.



At this point, Odysseus uses inertial measurements only. No cameras or lasers are guiding the spacecraft to the lunar surface because they would read lunar dust kicking up from the lander's engine. Odysseus' Inertial Measurement Unit (IMU) senses acceleration like a human's inner ears, which feel rotation and acceleration.

Terminal descent is like walking towards a door and closing your eyes the last three feet. You know you're close enough, but your inner ear must lead you through the door.

*Mission Maneuvers are Subject to Change

MISSION MANEUVER OVERVIEW

Odysseus is designed to land at one-meter-per-second velocity. Flight controllers expect about a 15-second delay before confirming the ultimate milestone, softly landing on the surface of the Moon. Intuitive Machines and its customers expect to conduct science investigations and technology demonstrations for approximately seven days before the lunar night sets on the south pole of the Moon, rendering Odysseus inoperable.

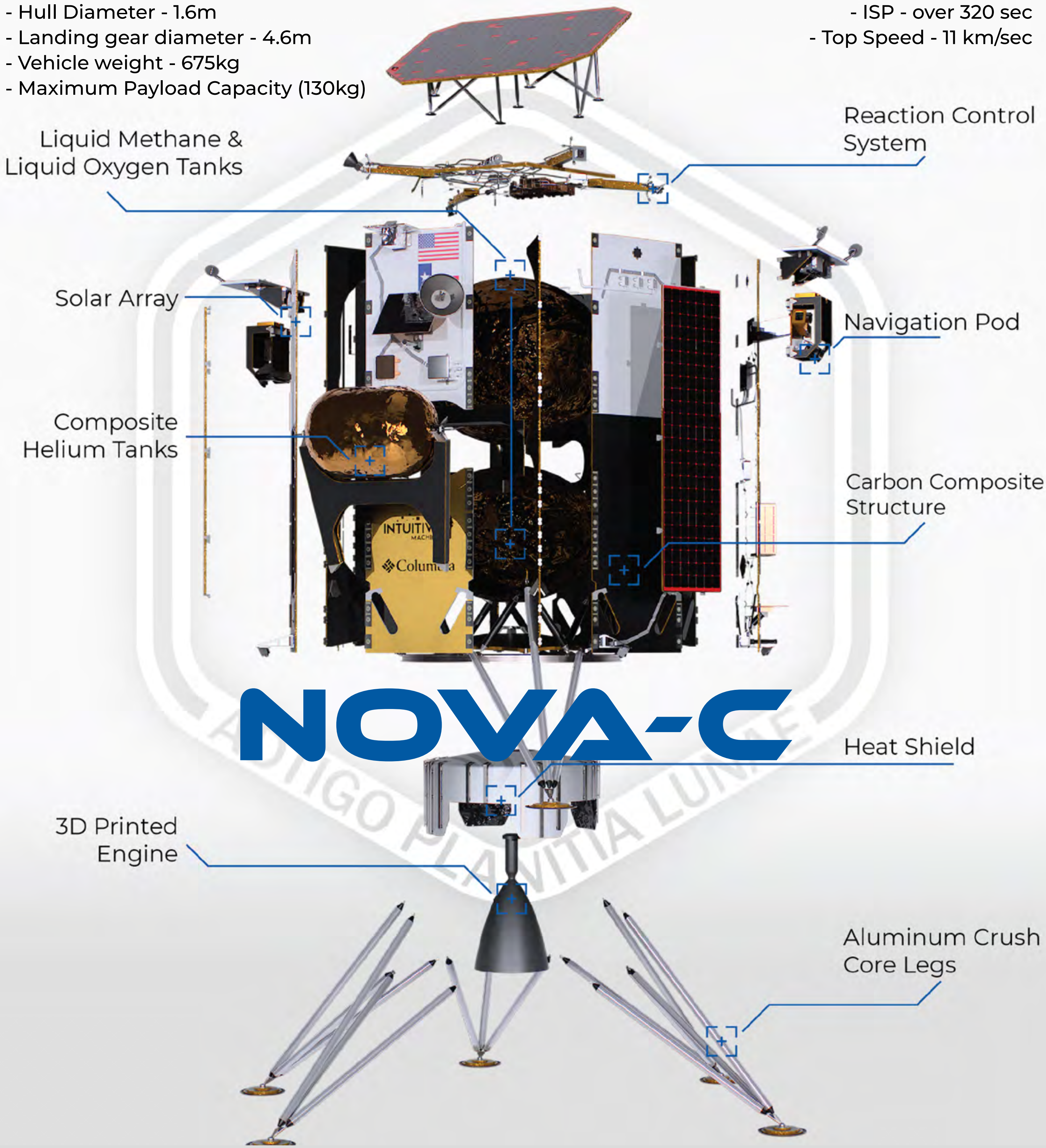
*Mission Maneuvers are Subject to Change

LUNAR LANDER OVERVIEW

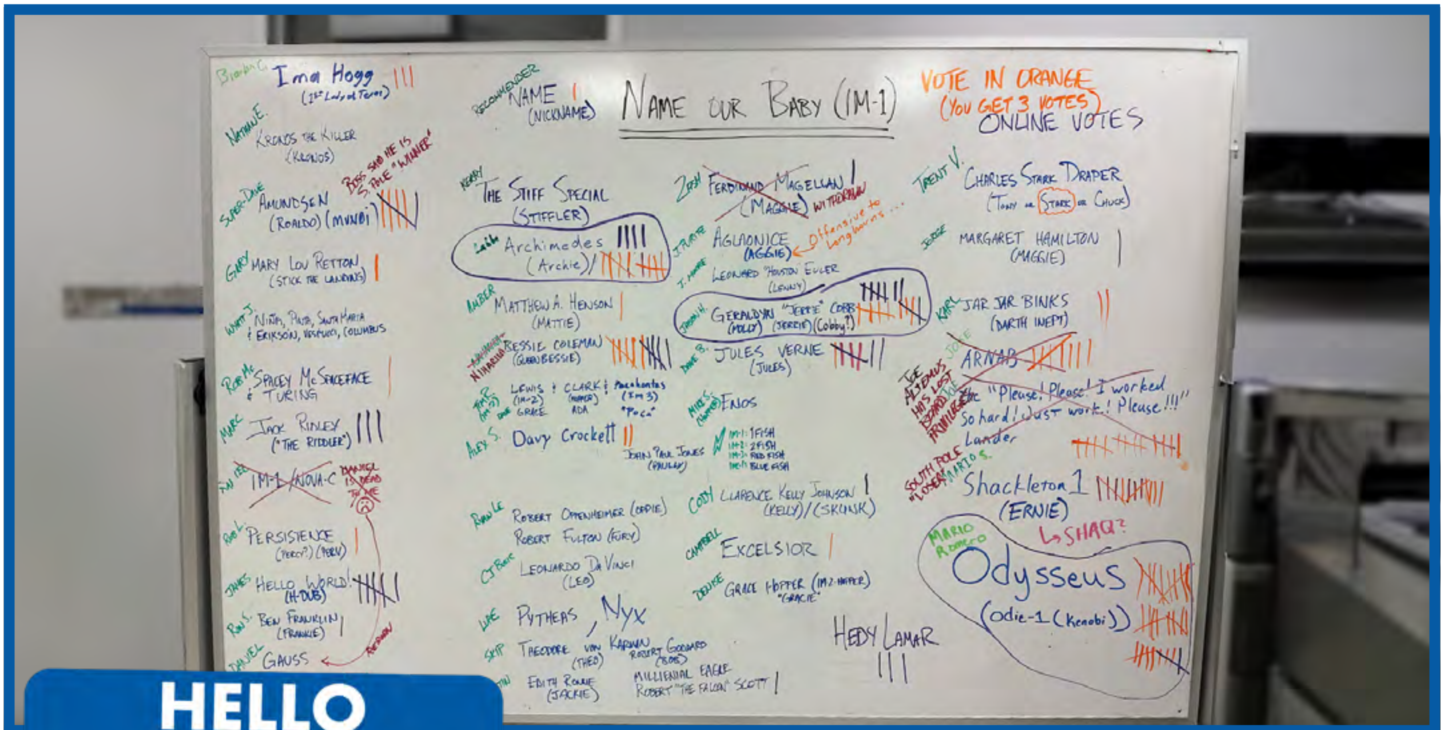
IM-1 | Nova-C CLASS LUNAR LANDER

Nova-C
- Height. 4.3 m
- Hull Diameter - 1.6m
- Landing gear diameter - 4.6m
- Vehicle weight - 675kg
- Maximum Payload Capacity (130kg)

ENGINE:
- Liquid Methane & Liquid Oxygen
- ISP - over 320 sec
- Top Speed - 11 km/sec



Odysseus: The IM-1 Nova-C Lunar Explorer



Intuitive Machines created its 130 kg payload capacity lunar lander and called that class of vehicle Nova-C. Nova means new, and C is the Roman numeral for 100. Think of Nova-C as Intuitive Machines' vehicle classification, similar to a sedan, SUV, or pickup truck. After years of developing Nova-C, it had a personality of its own, at times, as an unforgiving explorer that keeps Intuitive Machines engineers honest, demanding daily technical excellence.

Over two weeks, Intuitive Machines employees suggested lunar lander names on a whiteboard. In passing, folks voted for the lander name they favored before the company moved into a finalist vote.

The finalists were:

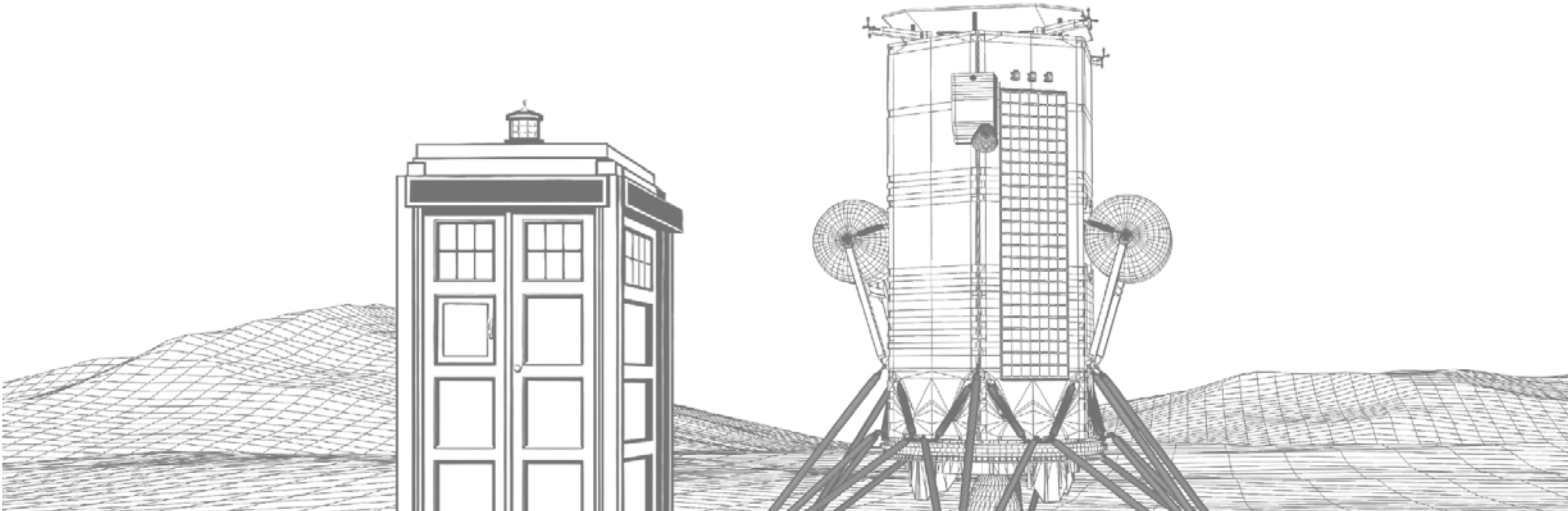
Archimedes (Archie)
Geraldyn Cobb (Molly, Jerrie, Cobby)
Odysseus (Odie)

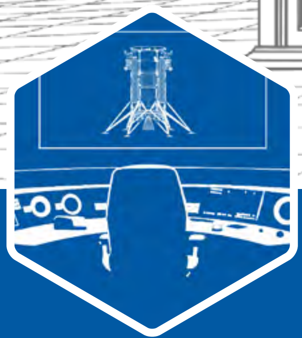
Odysseus was nominated by Assembly, Integration, and Test Engineer, Mario Romero. Romero described why the name Odysseus was a worthy name for Intuitive Machines' IM-1 mission lunar lander.

"For those who remember the epics The Iliad & The Odyssey, Odysseus (the wise & courageous) was the genius who devised the Trojan horse. But his adventure truly began after the Trojan War. His voyage should have been a quick, straight shot back home to Penelope in Ithaca; however, this journey takes much longer due to the many challenges, setbacks, and delays. Traveling the daunting, wine-dark sea repeatedly tests his mettle, yet ultimately, Odysseus proves worthy and sticks the landing back home after ten years."

FUN FACTS

Nova-C IS ROUGHLY THE SIZE OF AN OLD SCHOOL BRITISH PHONE BOX LIKE "TARDIS" IN DR. WHO



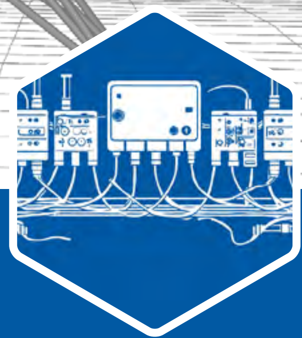


NOVA CONTROL

Nova Control was designed to resemble Star Trek's USS Enterprise Bridge

RADIOS

Nova-C uses two types of radios. Vehicle health and spacecraft status operate at a speed comparable to a 1976 modem. Meanwhile, the science data radios go 16,000 times faster.



MILE LONG CLUB

More than one mile of cables are installed on Nova-C.

Nova-C was originally designed to have a cylindrical hull. The company moved to a hexagonal structure to accommodate mass and payload integration constraints.

Intuitive Machines employees' names are etched into Nova-C's footer to permanently stamp on the Moon.

The lunar lander's main engine is offset to account for the overall center of gravity offset.

For a soft landing, Nova-C throttles down the main engine during terminal descent because the spacecraft's mass continually decreases because of fuel usage.

Nova-C is mostly made of carbon fiber and titanium.

The inertial measurement unit on Nova-C was partially tested attached to a Toyota Tundra.

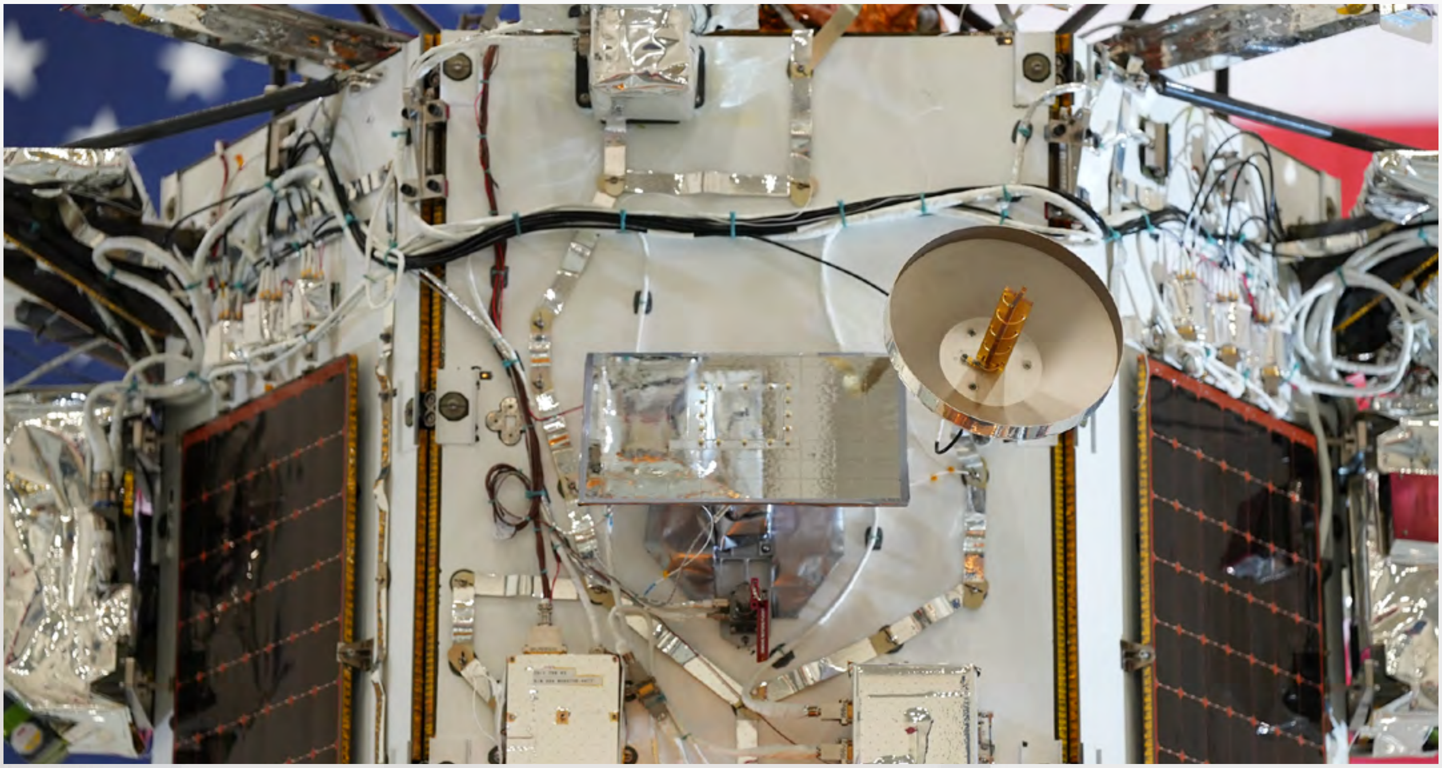
The lander battery packs store enough energy to fully charge approximately 130 dead iPhones.

Intuitive Machines engineers have generated over one million synthetic images of the Moon to test Nova-C's optical navigation and hazard detection algorithms.

Nova-C propagates its estimates of position, velocity, and attitude roughly five times faster than the average human blinks.

NASA PAYLOADS

ROLSES

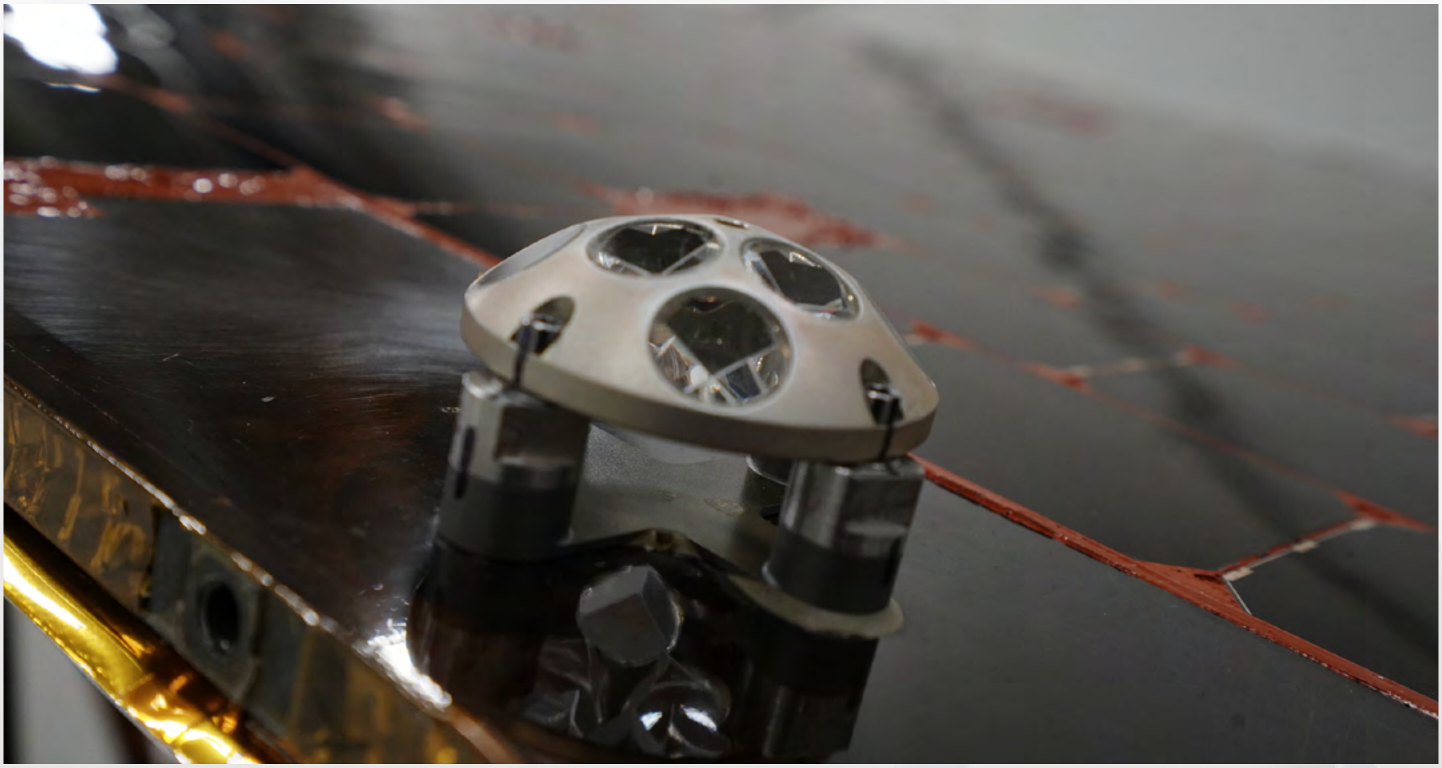


ROLSES: Radio Observations of the Lunar Surface Photoelectron Sheath

· Organization: NASA Goddard Space Flight Center
· Payload Mass: Approximately 13.1 kg
· Payload Dimensions: ROLSES consists of 4 antenna/pre-amp units and a Main Electronic Box for a total volume of 6440 cm3

ROLSES will use a low-frequency radio receiver system to (1) measure the electron plasma environment on the lunar surface (2) acquire observations of solar and planetary radio sources from the lunar surface, (3) sense near-surface charged dust, and (4) provide a first-ever measurement of the radio environment between 10 kHz and 30 MHz at the lander. Since the Moon does not have a global magnetic field to protect it, charged particles – from the solar wind, galactic cosmic rays, and solar flares – can make it to the lunar surface and create a plasma environment on the lunar surface that will levitate fine dust particles. The plasma environment measurements will provide critical information for Artemis astronauts, and the design of rovers, space suits and other exploration systems. ROLSES measurements of radio emissions from the Sun, planets, the galaxy, and even how radio noisy the Earth is will also provide a much-needed baseline for future sensitive lunar radio astronomy systems.

LRA

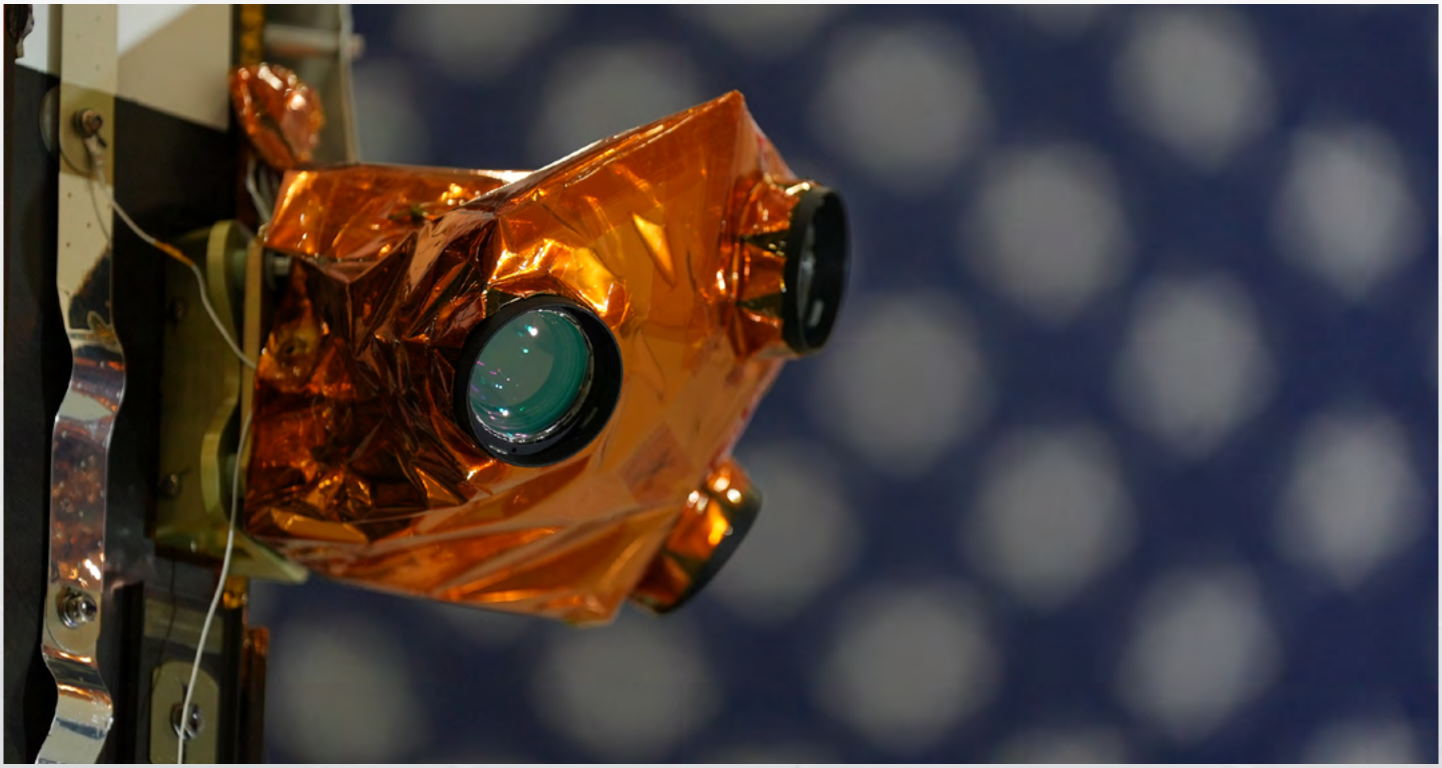


LRA: Laser Retro-Reflector Array

· Organization: NASA Goddard Space Flight Center
· Payload Mass: Approximately 20 g
· Payload Dimensions: O.D. 5.1 cm x 1.65 cm tall

LRA is a collection of eight approximately half-inch retro-reflectors – a unique collection of mirrors that is used for measuring distance – mounted to the lander. The mirror system reflects laser light directly backward to the orbiting spacecraft that emitted the laser light to precisely determine the lander's location on the surface of the Moon. LRAs are valuable because they can continue to be used as precision landmarks for guidance and navigation during the lunar day or night. A few LRAs surrounding an Artemis landing site or base camp can serve as precision landmarks to guide the arriving landers by aiding in autonomous and safe landing.

NDL



NDL: Navigation Doppler Lidar for Precise Velocity and Range Sensing

· Organization: NASA Langley Research Center
· Payload Mass: Approximately 15 kg
· Payload Dimensions: 40 cm x 29 cm x 14 cm

The NDL is a LIDAR-based (Light Detection and Ranging) sensor composed of an optical head with three small telescopes and a box with electronics and photonics. NDL uses lasers to provide extremely precise velocity and range (distance to the ground) sensing during the descent and landing of the lander. This instrument operates on the same principles of radar, similar to a police radar detector, but uses pulses of light from a laser instead of radio waves and with very high accuracy. This will enhance the capabilities of space vehicles to execute precision navigation and controlled soft landings.

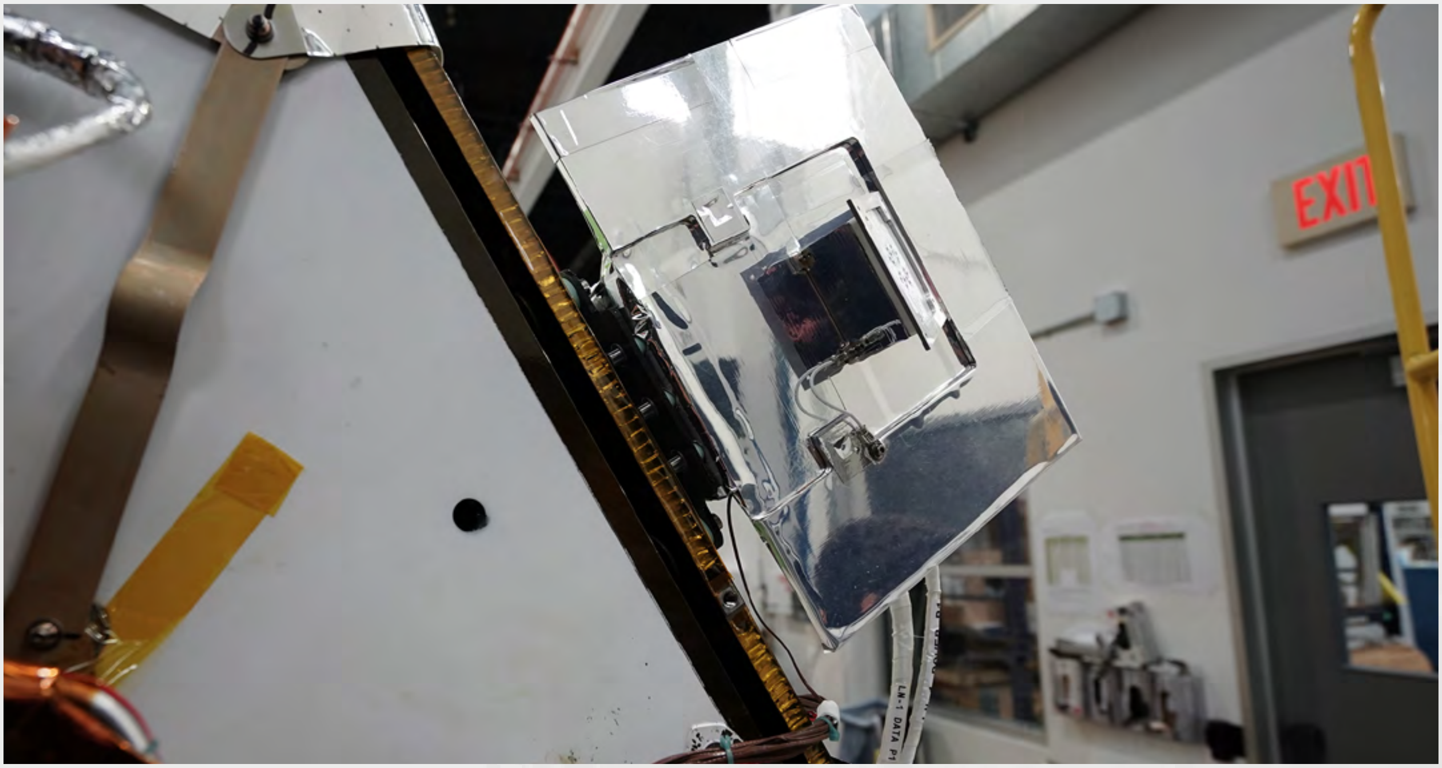
SCALPSS

SCALPSS: Stereo Cameras for Lunar Plume-Surface Studies

· Organization: NASA Langley Research Center
· Payload Mass: NTE 6.0 kg
· Payload Dimensions: SCALPSS consists of six elements (1 Data Storage Units, 1 USB Hub, and 4 cameras)

SCALPSS will capture images of the effects of the lander's engine plume as it interacts with the lunar surface while Odysseus is descending, and as the dust plume settles after the spacecraft lands. This information is critical for validating predictive models on how particles on the lunar surface are moved by rocket engine exhaust and allows scientists to analyze the close-up imagery of the surface of the Moon. Data from SCALPSS can be used for future Artemis vehicle designs to ensure the safety of both the landers and any other surface assets nearby during landing.

LN-1

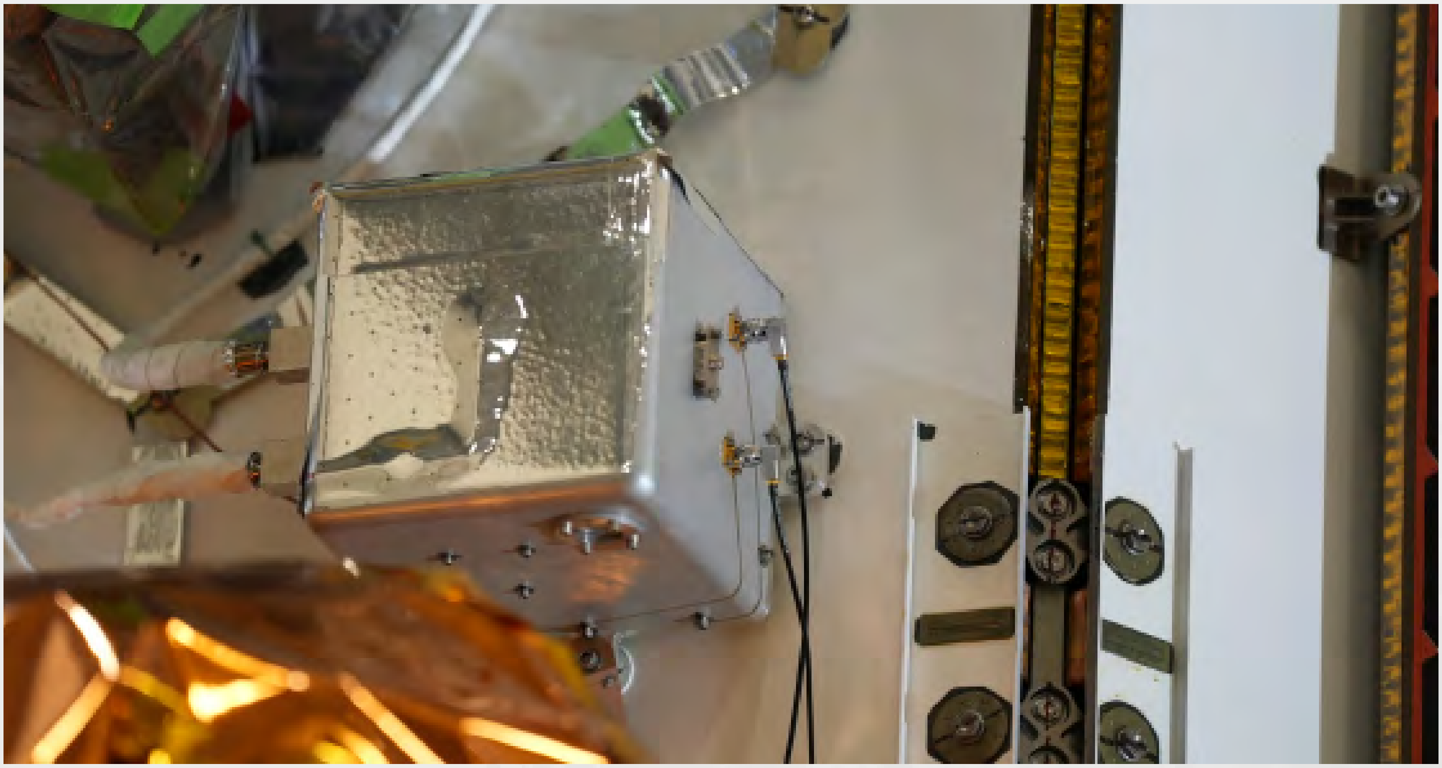


LN-1: Lunar Node 1 Navigation Demonstrator

· Organization: NASA Marshall Space Flight Center
· Payload Mass: Approximately 3 kg
· Payload Dimensions: 22 cm x 33 cm x 11 cm

LN-1 is a small CubeSat-sized S-band radio navigation beacon that will demonstrate autonomous spacecraft positioning to support future lander, surface (like rovers), and orbital operations. Radio beacons like LN-1 can guide incoming and outgoing spacecraft and landers with precision and reduce fuel consumption. This experiment will leverage NASA's Deep Space Network (DSN) for one-way ranging and Doppler tracking to provide a real-time position like how GPS works on Earth. As future Artemis communication and navigation network systems are developed, hardware like LN-1 and its capabilities could be part of a much larger infrastructure.

RFMG
(RADIO FREQUENCY MASS GAUGE STATEMENT)



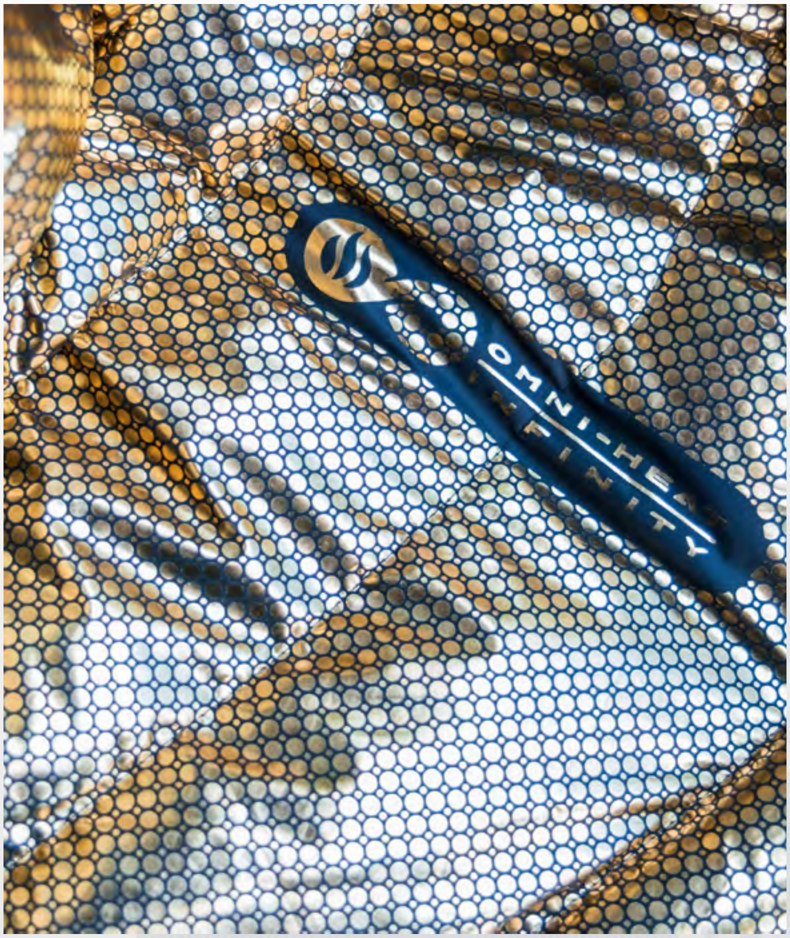
RFMG: Radio Frequency Mass Gauge statement

· Organization: NASA Glenn Research Center
· Payload Mass: 2 kg
· Payload Dimensions: 20 x 20 x 15 cm, there is also a small antenna sensor in each tank

RFMG technology uses radio waves and antennae in Nova-C's tank to measure exactly how much propellant is available. RFMG could be crucial during future long-duration missions that will rely on spacecraft fueled by cryogenic propellants, like liquid hydrogen, liquid oxygen, or liquid methane. These propellants are highly efficient but are tricky to store as they can evaporate quickly, even at low temperatures. Being able to accurately measure spacecraft fuel levels will help scientists maximize resources as NASA moves toward its goal of returning humans to the Moon through Artemis.

COMMERCIAL PAYLOADS

COLUMBIA SPORTSWEAR

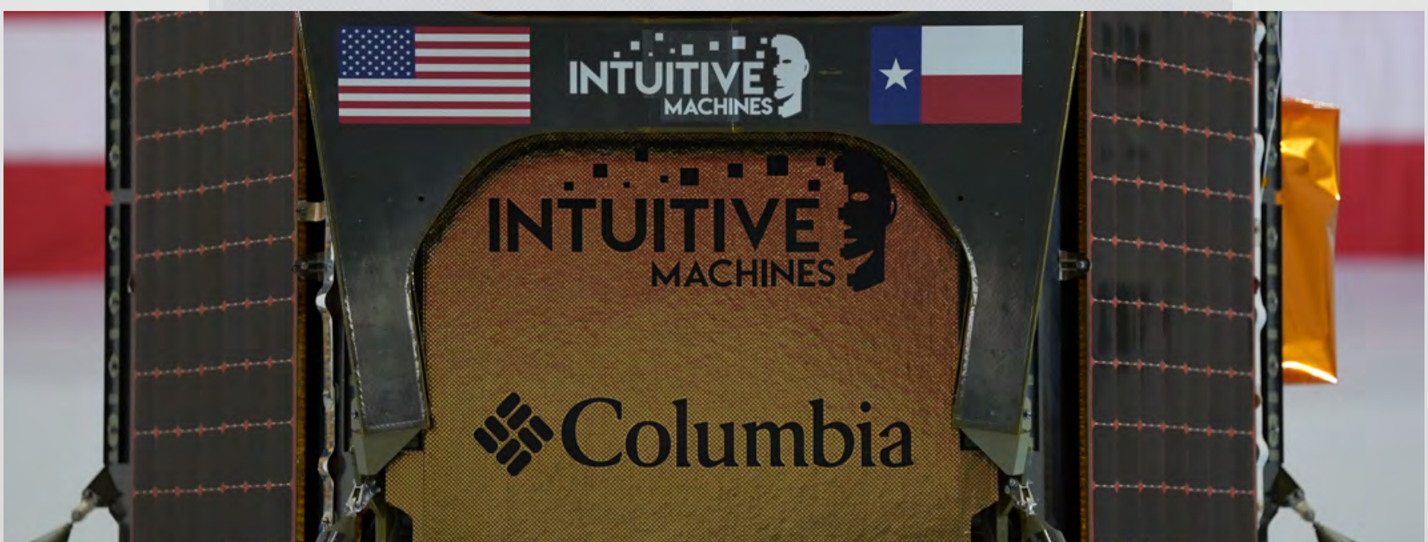


In partnership with Intuitive Machines, Columbia is testing the limits of its innovations by sending Omni-Heat Infinity to the Moon. Originally inspired by space blankets on Apollo missions, the same Omni-Heat Infinity technology found in jackets on Earth will help protect the Nova-C lunar lander from the extreme temperatures of outer space.

-208F (-133C) / 250F (121C)

Intuitive Machines and Columbia tested the thermal reflective material to aerospace industry standards. Thermal modeling revealed that Omni-Heat Infinity provides a benefit for heat reflection when used as a panel covering, and that is where the technology will be used on Nova-C. Intuitive Machines engineers incorporated Columbia's Omni-Heat Infinity thermal reflective technology onto Nova-C's A2 closeout panel to protect Nova-C's cryogenic propulsion tank.

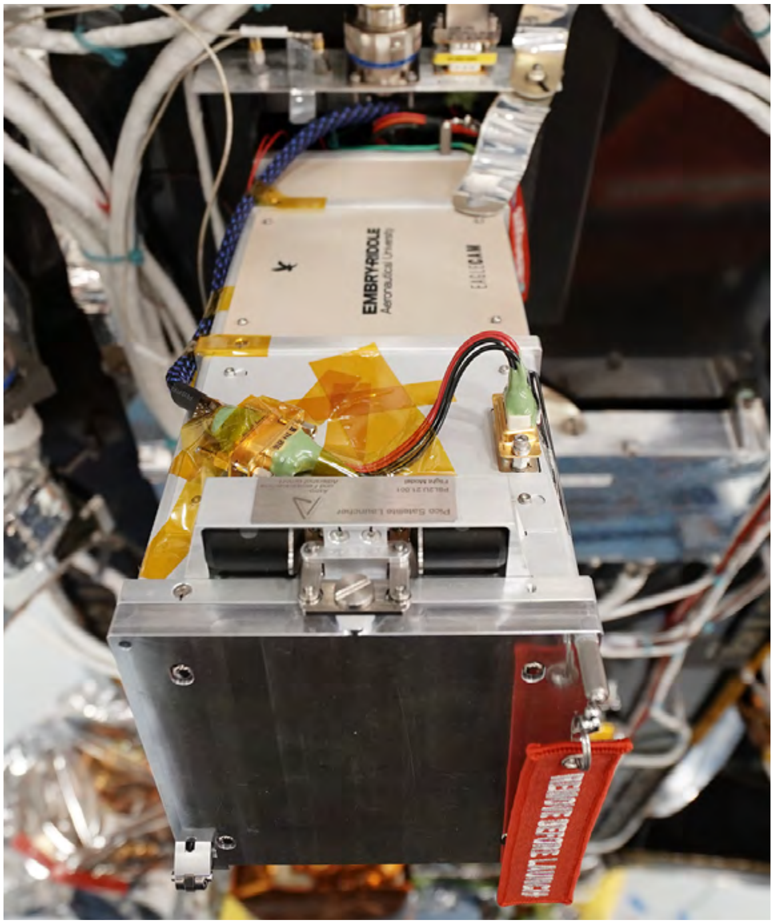
For Columbia, the IM-1 mission is an unparalleled opportunity for exploration and discovery, paving the way for advancements in technologies and materials innovations that will enhance its products and the lives of its customers.

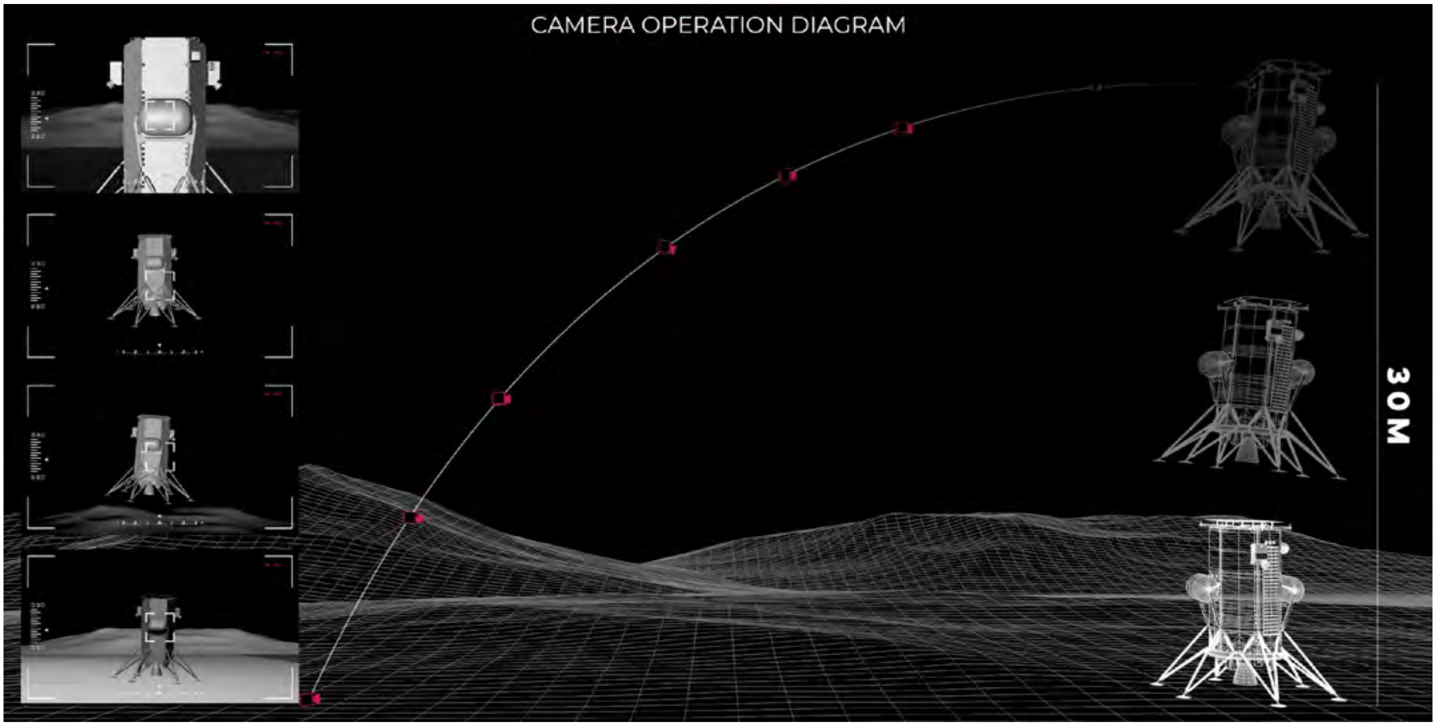


EMBRY-RIDDLE EAGLECAM

Intuitive Machines co-founder, Embry-Riddle alumnus Steve Altemus ('87), challenged his alma mater to engineer an out-of-this-world selfie when he visited the university in 2019. Students and faculty accepted Altemus' challenge and created EagleCam, a camera system to capture the world's first-ever third-person picture of a spacecraft making an extraterrestrial landing. Additionally, the device will test an electrostatic dust-removal system, which could lead to future advances in spacesuit technology. EagleCam was created in the university's Space Technologies Laboratory, located in Embry-Riddle's Research Park.

Eaglecam is designed to deploy off of Nova-C approximately 100ft (30m) above the lunar surface and capture images as the spacecraft touches down on the Moon.





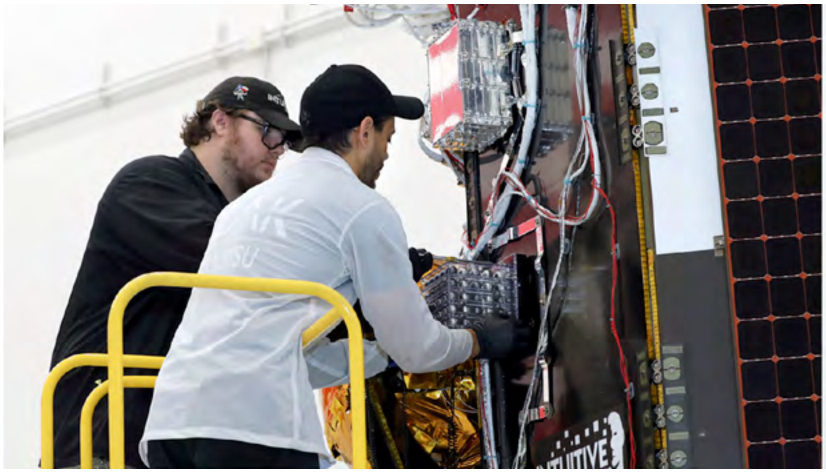
JEFF KOONS: MOON PHASES

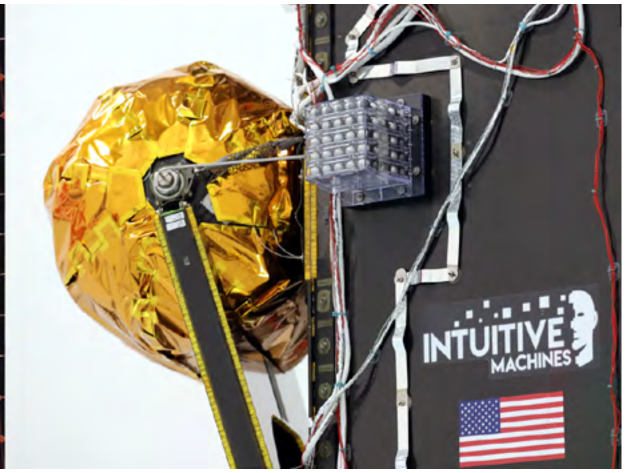
In celebration of human achievement, Jeff Koons will send a group of sculptures to the Moon on an Intuitive Machines Nova-C Lunar Lander.

Photos: Chris Farina

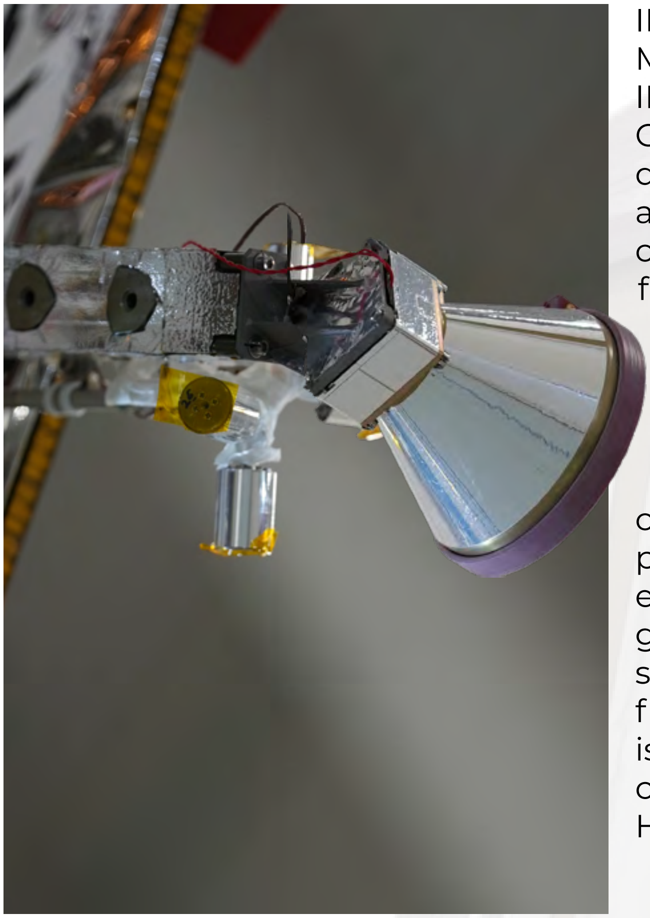
As a symbol of human curiosity and the desire to achieve, Jeff Koons: Moon Phases comprises 125 unique artworks, each consisting of 3 components: a sculpture that will be installed on the Moon, a sculpture that will stay on the Earth, and an NFT that corresponds with the sculptures on the Moon and the Earth. The 125 miniature stainless steel Moon Phase sculptures will be displayed on the Moon in a cube, which was designed and built by 4Space in consultation with Koons. The Moon Phase artworks are associated with individuals who made important accomplishments in human history. The list of names is universal, from various cultures throughout the world, fields, and time periods. Displayed in front of each artwork, the names memorialize the figures. In this way, Koons honors some of the greatest achievements of the past to inspire future generations.

Jeff Koons: Moon Phases is Koons's most ambitious work to date and brings together leaders in the scientific and creative fields. Koons's project was initiated by Patrick Colangelo of NFMoon and Chantelle Baier of 4Space, and is presented by Pace Verso. Intuitive Machines will bring Koons's sculptures to the Moon as part of the historic IM-1 mission, marking the first authorized artworks to be placed on the surface of the Moon.



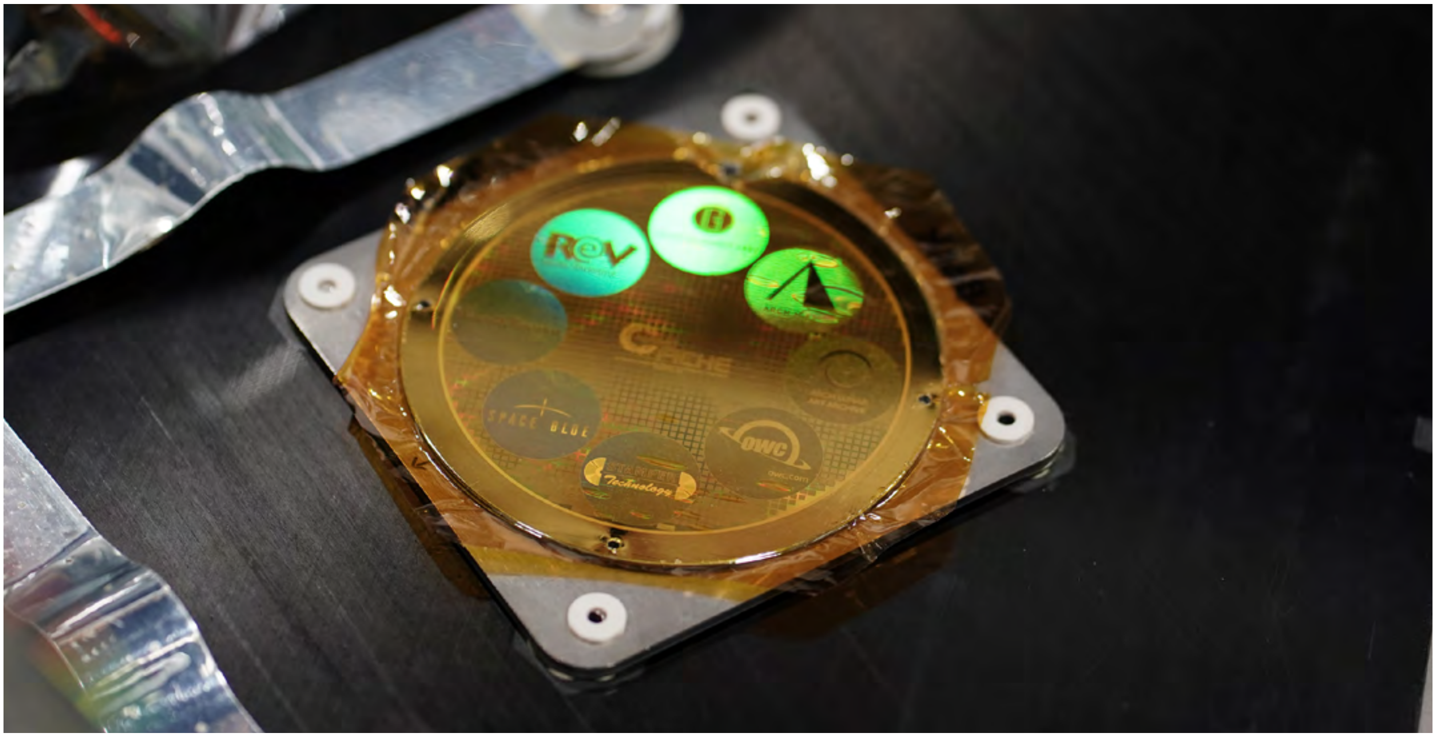


INTERNATIONAL LUNAR OBSERVATORY ASSOCIATION: ILO-X



ILO-X is a precursor to the ILOA Hawai'i flagship Moon South Pole Observatory ILO-1. The ~0.6 kg ILO-X instruments, built for ILOA by Toronto-based Canadensys Aerospace, includes a miniaturized dual-camera lunar imaging suite (one wide field and one narrow field). It will aim to capture some of the first images of the Milky Way Galaxy Center from the surface of the Moon, as well as performing other celestial astronomy / Earth / local lunar environment observations and exploration technology validations – including functionality and survivability in the lunar environment. This mission will be the first Hawaiʻi-based organization's cameras on the Moon. Hawaiʻi is a place that honors science, discovery and mindful exploration. The ILO-X narrow-field camera was given the name Ka ʻImi (The Search) after a Hawai'i student naming contest. Receiving this name from the next generation of scientists of Hawaiʻi is a great honor and celebration of the unique communities and knowledge that exists on the Hawaiian Islands of which ILOA calls home.

GALACTIC LEGACY LABS: LUNAPRISE



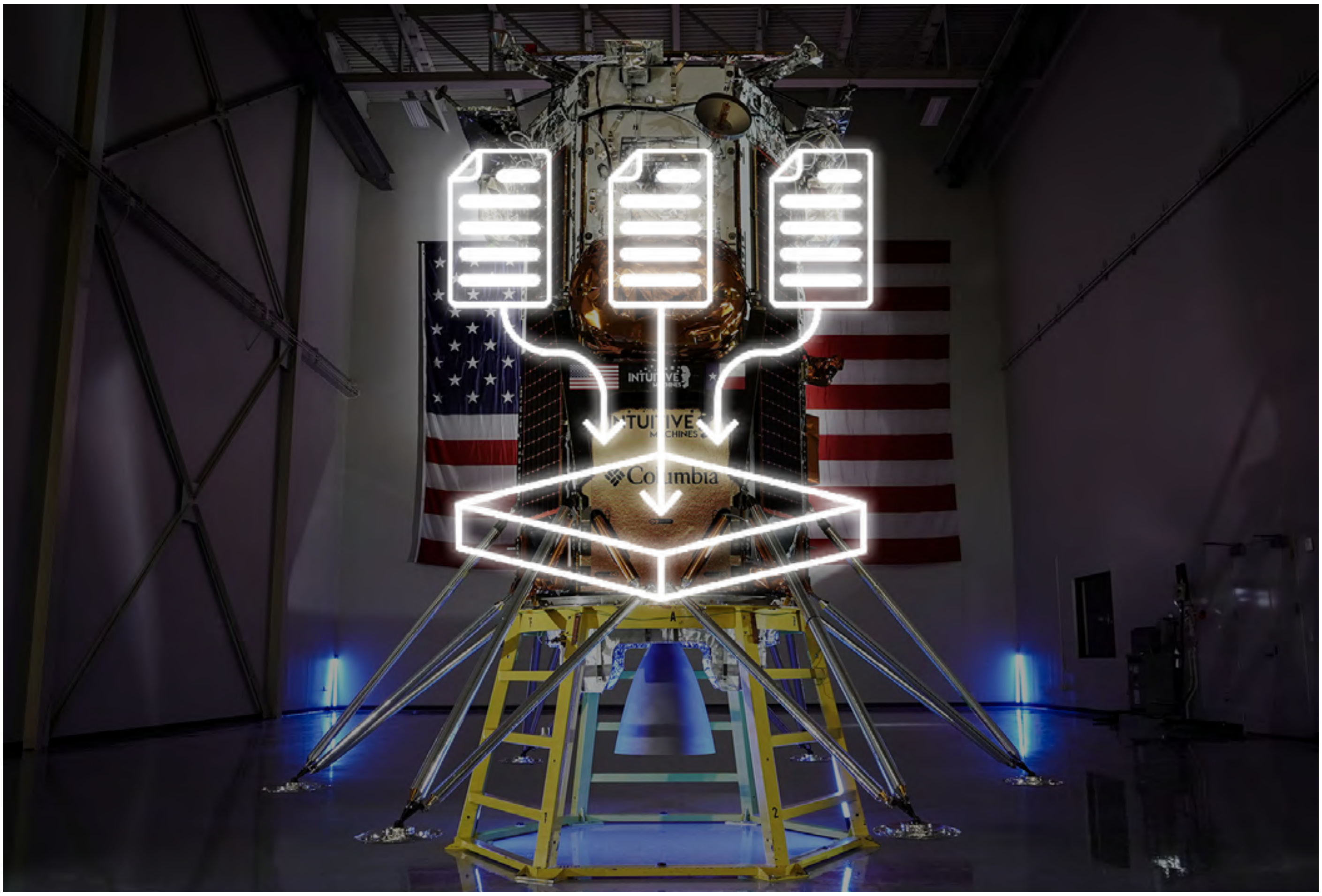
Mission Name: Lunaprise

Mission Organizer: Galactic Legacy Labs llc, curator Space Blue & Arch Mission Foundation

Lunaprise Founding Members: Nova Spivack, Lori Taylor, Lanette Phillips, Chris Habachy

Mission Objective: To establish a secure lunar repository called the Lunaprise in support of Arch Missions Foundation's billion-year archive, preserving human knowledge for eternity. These messages are called Lunagrams and can be submitted online as text, an image, or both. Music and video files are also accepted. An archive from the nonprofit Arch Mission Foundation, including the English Wikipedia, The Rosetta Project, Long Now Foundation content, Project Gutenberg content, and other cultural archive datasets are also included in our payload.

LONESTAR DATA HOLDINGS INC.



Lonestar's mission is working to send increasingly capable data centers to the Moon to meet the needs of its customers for secure premium data storage and edge processing. Lonestar's Independence payload represents a key technology demonstration of the company's Disaster Recovery as a Service (DRaaS) utilizing the unique operational properties offered from the Moon. Working with Intuitive Machines, Lonestar is storing digital data on board the Nova-C lander for its customers and transmitting the first documents off planet for data storage to the Moon while in turn transmitting the first documents back from the Moon. Think in terms of the ultimate in digital refresh and restore on a planetary scale from its most secure backup location. This first small step is in preparation for Lonestar's larger data center payload, Freedom, scheduled to fly with Intuitive Machines on their second scheduled lunar mission.

(**L**UDACRIS **A**CRONYM **S**UPPORT **T**RAINING)

L.A.S.T PAGE

AFM - Automated Flight Management

AOS - Acquisition of Signal

CLPS - Commercial Lunar Payload Services

DOI - Descent Orbit Insertion

DLS - Designated Landing Site

DraaS - Disaster Recovery as a Service

FDO - Flight Dynamics Officer

GNC - Guidance Navigation and Control

GSFC - Goddard Space Flight Center

GLL - Galactic Legacy Labs

HGA - High Gain Antenna

HRN - Hazard Relative Navigation

IM-1 - Intuitive Machines Mission One

ILS - Intended Landing Site

IMU - Inertial Measurement Unit

ILOA - International Lunar Observatory Association

ILO-X - International Lunar Observatory X

LN-1 - Lunar Node One

LTN - Lunar Tracking Network

LVSEP - Launch Vehicle Separation

LOI - Lunar Orbit Insertion

LLO - Low Lunar Orbit

LOS - Loss of Signal

LRA - Laser Retro-Reflector Array

MECO - Main Engine Cut Off

MAPS - Multi-spacecraft Autonomous Positioning System

NASA - National Aeronautics and Space Administration

NDL - Navigation Doppler Lidar

NFT - Non-Fungible Token

NTE - Not to Exceed

OD - Orbit Determination

PDI - Powered Descent Initiation

PN - Position Navigation

ROLSES - Radio Observations of the Lunar Surface photo Electron Sheath

RCS - Reaction Control System

SCALPSS - Stereo Cameras for Lunar Plume-Surface Studies

TCM - Trajectory Correction Maneuver

TIG - Time of Ignition

TRN - Terrain Relative Navigation

USB - Universal Serial Bus