



Astrobotic's Peregrine lander navigation system will deliver payloads to the Moon in 2021.

Lunar Technology with Roots in SBIR/STTR Will Reach the Moon

NASA pledged to land the first woman and the next man on the Moon by 2024 to maintain a sustainable presence by 2028, and with that goal comes several years of high-intensity preparation. Two important steps towards humanity's return to the Moon include acquiring new data through lunar surface research and demonstrating technologies for the development of future landers, both undertakings of the agency's Commercial Lunar Payload Services (CLPS) initiative.

Under CLPS, commercial companies partner with NASA to fly specific instruments to the lunar surface. The **potential payloads** include instruments for conducting new lunar science—such as detecting and sampling lunar resources, or measuring lunar environment radiation—as well as technologies that will allow for new operational techniques—such as improved navigation positioning systems.

Of the 11 companies selected to deliver payloads to the moon, four developed technology within the NASA SBIR/STTR Program. Pittsburgh, PA-based Astrobotic, Inc. is one of these SBIR/STTR firms, and has received two contracts since July 2020 for CLPS-related deliveries. Astrobotic was one of the first three companies contracted to deliver NASA's payloads, receiving a \$79.5 million contract to land on the Moon in 2021. The payloads include Astrobotic's lunar rover, whose development directly stems from the company's work with

Projects

Peregrine and Griffin lander navigation system and CubeRover for lunar missions

Mission Directorates

- Science
- Human Exploration and Operations
- Space Technology

Follow-on NASA Success

More than \$270 million from NASA for Moon to Mars initiatives

Snapshot

Astrobotic, a small business based in Pittsburgh, PA, received more than \$270 million in contracts from NASA to support various aspects of the agency's return to the Moon. The company's compact lunar rover and precision lunar lander technology, which will deliver payloads to the lunar surface, were developed with funds from the NASA SBIR/STTR Program.

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the SBIR/STTR Program. In June 2020, Astrobotic received a \$199.5 million contract, this time to deliver NASA's Volatiles Investigating Polar Exploration Rover (VIPER) to the South Pole of the Moon by late 2023. The lunar landers selected for both deliveries were developed by Astrobotic in part with SBIR/STTR awards.

Beginnings in SBIR/STTR

During its first mission, Astrobotic's lunar lander is scheduled to deliver up to 90 kilograms of cargo for NASA as well as other customers in 2021. But before Astrobotic could commit to delivering 90 kilograms in payloads to the moon, its early work involved experimenting with deliveries lighter than 2 kilograms. Robert Mueller, NASA Kennedy Space Center's (KSC) Senior Technologist, and his team at Swamp Works—a lean and rapid development lab at KSC—first collaborated with Astrobotic on this payload-bearing technology in the early 2000s when the company was founded. Mueller was acquainted with Astrobotic due to its ties to Carnegie Mellon University (CMU)—the company was founded by CMU alumni to pursue the Google Lunar X Prize, and it continues to work closely with CMU.



Astrobotic is a space robotics company that seeks to make space accessible to the world.

“The strength of Astrobotic is that it has a strong partnership with CMU, so it has a pipeline of students at the university that transition into Astrobotic. It's a great collaboration,” says Mueller. He encouraged Astrobotic to apply with CMU to the NASA SBIR/STTR Program. In particular, Astrobotic and CMU were the ideal candidates for an STTR award, which funds the partnership between a small business and a research institution to establish the scientific, technical, commercial merit and feasibility of their proposed innovation. In 2009 Astrobotic received Phase I SBIR and STTR awards, which led to two corresponding Phase II awards that same year.

John Thornton, CEO of Astrobotic, says, “SBIR and STTR awards are really how we got the company going and became the lifeblood of the company.” Starting with its first award in 2009, the small business has received 20 awards through 2019 from the SBIR/STTR Program, including post-Phase II add-ons, and it collaborates with six of the ten NASA centers nationwide. With some of its earliest SBIR awards working with KSC and Swamp Works, Astrobotic subsequently developed the basis for [CubeRover](#), a highly configurable and modular miniature rover that weighs less than 2 kilograms for ease of transportation and reduced cost of delivery. The first CubeRover is poised to arrive on the moon in 2021, transported by another Astrobotic technology with roots in the SBIR/STTR Program, known as the [Peregrine Lander](#).

In 2014, NASA's SBIR/STTR solicitation sought technology that could perform sample-return missions from exoplanetary destinations, such as Mars and distant moons, with varying gravity and geography. Astrobotic received a Phase I SBIR award to develop safe and precise robotic navigation and landing technology for challenging terrain. This Phase I prototype evolved into the navigation system of Peregrine and also Griffin, the two lunar landers that will fly NASA payloads to the Moon.



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– John Thornton
CEO of Astrobotic

Expanding Beyond SBIR/STTR

Peregrine, Griffin, and CubeRover grew with the NASA SBIR/STTR Program and will contribute significantly on high impact NASA missions. The CLPS contract NASA awarded Astrobotic in 2019 provides for up to 14 payload deliveries to the Moon through 2028. With Astrobotic's first CLPS delivery, Peregrine will deliver NASA science, exploration and technology demonstration payloads to the Moon by 2021. These payloads will contribute to the establishment of a sustainable and survivable lunar habitat. However, Peregrine is not an asset exclusively for NASA's use. In keeping with a core goal of the SBIR/STTR

program, Astrobotic commercialized its technology and offers lunar delivery services to customers around the world. In the same mission as the one for NASA, Peregrine will transport a total of 26 payloads for customers in six countries, in keeping with its mission statement "to make space available to the world."

With a goal of funding technologies at the crucial "tipping point" of final development, the **NASA Tipping Point program**, part of NASA's Science Technology Mission Directorate, awarded \$10 million to Astrobotic to advance the company's precision landing system. Astrobotic's CubeRover will also support NASA's Artemis mission with an additional \$2 million in funding from Tipping Point, providing the push to bring the CubeRover product line to market. Like Peregrine, CubeRover's low-cost alternate delivery service to the Moon's surface is available for both government and commercial applications.

From its beginnings pursuing the Google X prize at CMU and obtaining early wins with the NASA SBIR/STTR Program to high-impact contracts with NASA in support of the Artemis program, Astrobotic has covered a lot of ground in a short period of time. The company's contracts from NASA for Moon to Mars initiatives total more than \$270M as of July 2020, and with non-NASA customers buying in as well, Astrobotic proves to be a credible player even among large businesses in powering the space economy. Mike Vinje, Center Technology Transition Lead at the Kennedy Space Center, attributes Astrobotic's expedient success to the team's forward-thinking mindset: "They're a small business that never thought they were a small business."