Four-legged jumping robots to explore the moon

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The LEAP rover is based on the legged robot, ANYmal, developed at ETH Zürich and its spin-off ANYbotics. Credit: ETH Zürich/RSL Robotics Labs

A four-legged robot trained through artificial intelligence has learned the same lesson as the Apollo astronauts—that jumping can be the best way to move around on the surface the moon. An update on LEAP (Legged Exploration of the Aristarchus Plateau), a mission concept study supported by ESA to explore some of the most challenging lunar terrains, has been presented today at the Europlanet Science Congress (EPSC) 2022 in Granada by Patrick Bambach.

"LEAP's target is the Aristarchus plateau, a region of the moon that is particularly rich in geologic features but highly challenging to access," said Patrick Bambach of the Max Planck Institute for Solar System Research in Germany. "With the robot, we can investigate key features to study the geologic history and evolution of the moon, like the ejecta around craters, fresh impact sites, and collapsed lava tubes, where material may not have been altered by space weathering and other processes."

The LEAP team is working towards the robot being integrated on ESA's European Large Logistic Lander (EL3), which is scheduled to land on the moon multiple times from the late 2020s to the early 2030s. LEAP is based on the legged robot, ANYmal, developed at ETH Zürich and its spin-off ANYbotics. It is currently adapted to the lunar environment by a consortium from ETH Zurich, the Max Planck Institute for Solar System Research, OHB, the University of Münster, and the Open University.

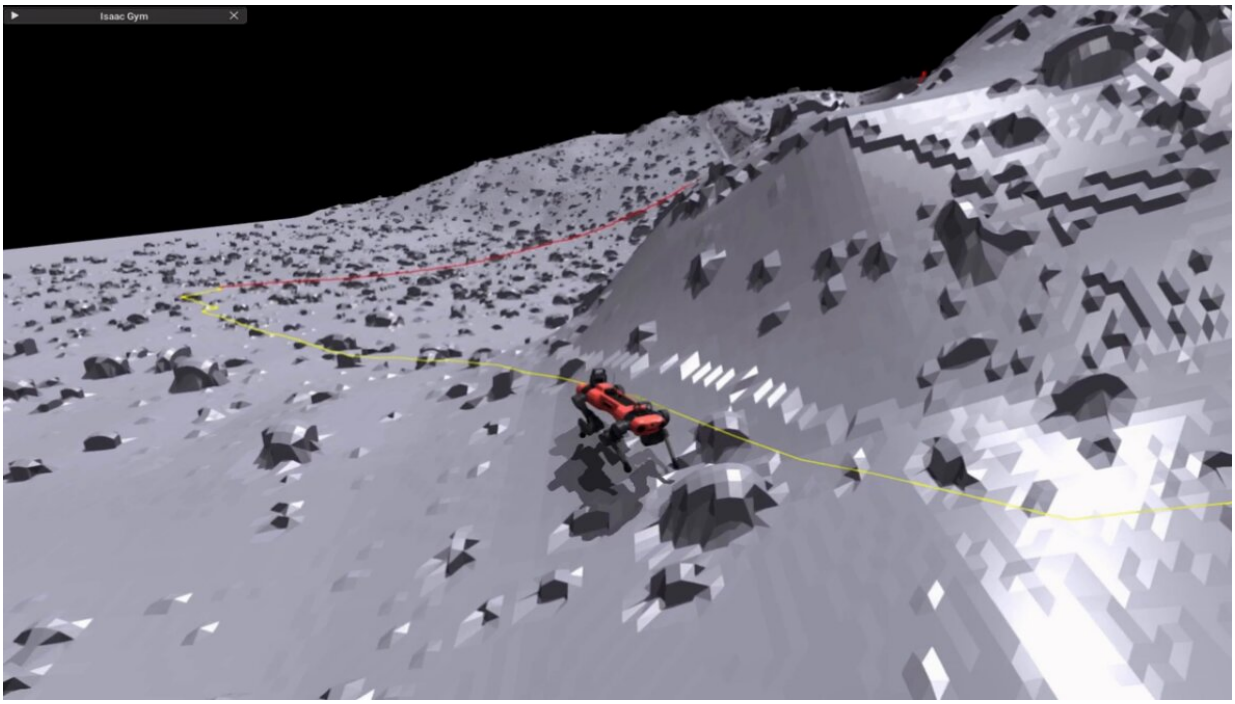
Different versions of the legged robot, ANYmal, developed at ETH Zürich and its spin-off ANYbotics. Credit: ETH Zürich/RSL Robotics Labs

"Traditional rovers have enabled great discoveries on the moon and Mars, but have limitations," said Bambach. "Exploring terrain with loose soil, large boulders or slopes over 15 degrees are particularly challenging with wheels. For example, the Mars rover, Spirit, had its mission terminated when it got stuck in sand."

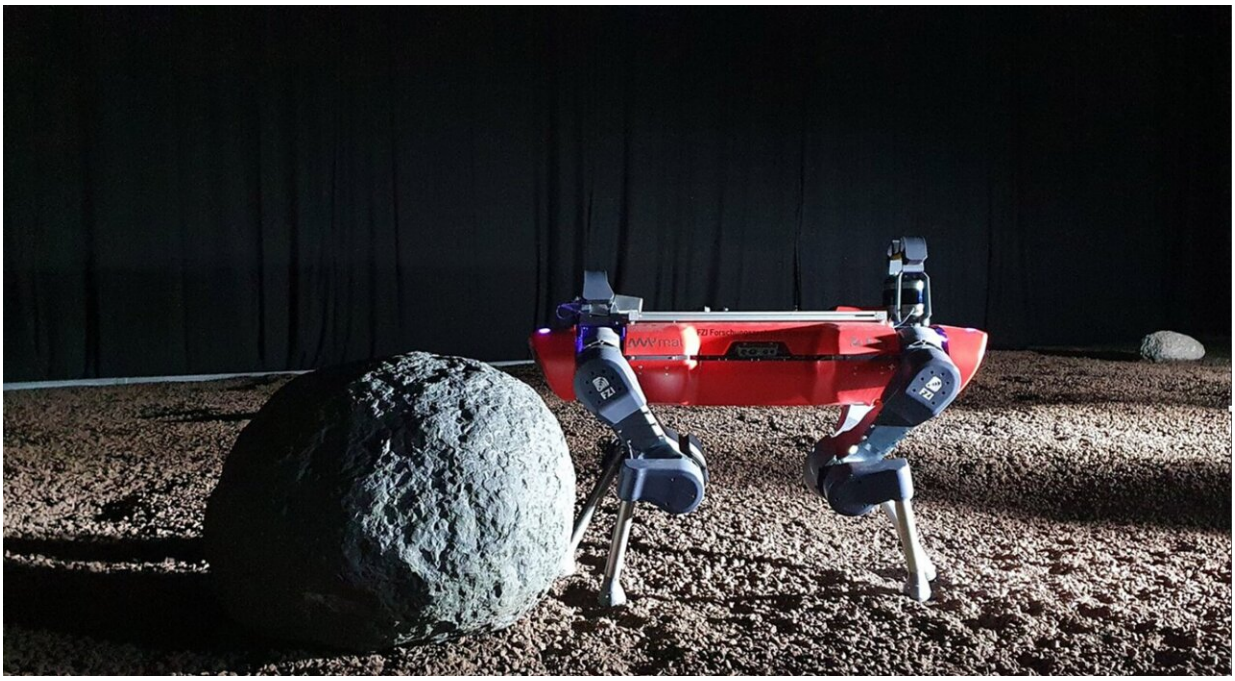
ANYmal can move in different walking gaits, enabling it to cover large distances in a short amount of time, climb steep slopes, deploy scientific instruments, and even recover in the unlikely event of a fall. The robot can also use its legs to dig channels in the soil, flip over boulders or smaller rocks for further inspection, and pick up samples.

Initially, the robot has been trained using a Reinforcement Learning approach in a virtual environment to simulate the lunar terrain, gravity

and dust properties. It has also been deployed in the field for an outdoor hike.



The LEAP rover is trained using a Reinforcement Learning approach in a virtual environment to simulate the lunar terrain, gravity and dust properties. Credit: ETH Zürich/RSL Robotics Labs



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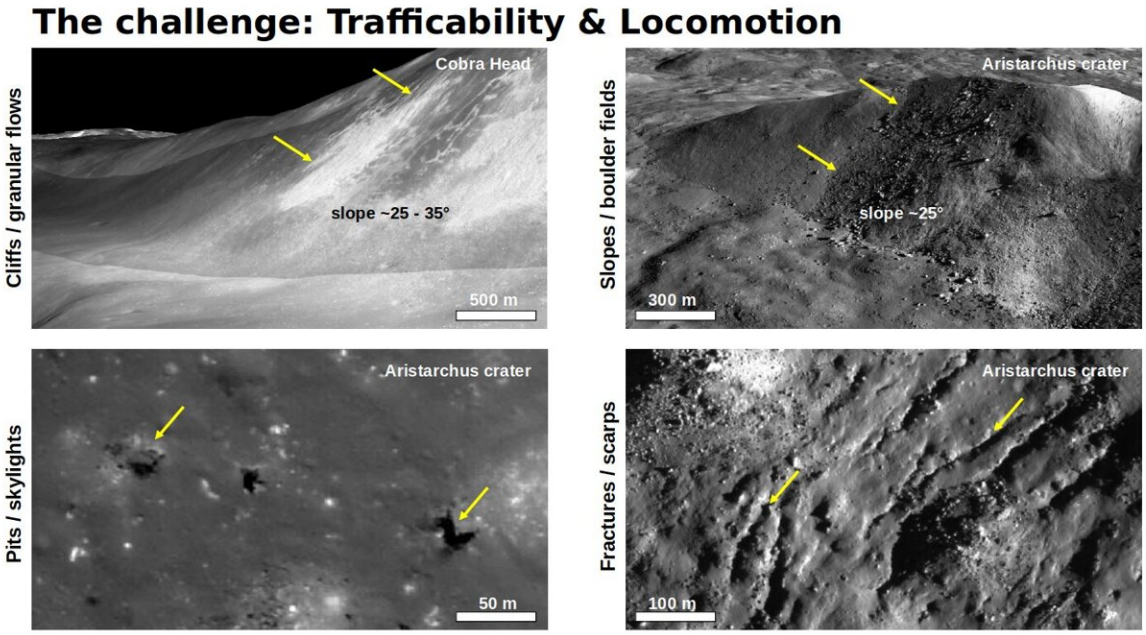

LEAP's target is the Aristarchus plateau, a region of the Moon that is particularly rich in geologic features but highly challenging to access. Credit: NASA/ESA

"Interestingly, ANYmal started to use a jumping-like mode of locomotion, just as the Apollo Astronauts did—realizing that jumping can be more energy efficient than walking," said Bambach.

The current design remains below 100 kg and includes 10 kg of scientific payload mass, notionally being capable of carrying multispectral sensors, ground penetrating radar, mass spectrometers, gravimeters, and other instrumentation.

"LEAP's ability to collect selected samples and bring them to a lander or ascent vehicle offers additional exciting opportunities for sample a return missions in highly challenging environments on the moon or Mars," said Bambach.

More information: www.epsc2022.eu/

Provided by Europlanet

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