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SHAPING THE FUTURE OF AEROSPACE

Space robotic arms and rovers push the limits of lunar exploration

BY SAMANTHA CHAPIN, ERIK KOMENDERA AND JIAN-FENG SHI

The **Space Automation and Robotics Technical Committee** works to advance the development of automation and robotics technologies and their applications to space programs.

In January, **NASA** and **industry collaborators** published a paper on the **Space Robotics Operating System**. This open-source framework for writing space robotic flight software aims to create a quicker path to flight and lower the cost of new missions.

In February, NASA selected the **Aerospace Corp.** to operate the **Consortium for Space Mobility and ISAM Capabilities** to bring together industry, academia and government to collaborate on in-space servicing, assembly and manufacturing development.

In March, progress was made on multiple lunar rovers. NASA began assembly of its **Volatiles Investigating Polar Exploration Rover, or VIPER**, at **Johnson Space Center** in Texas, integrating instruments delivered from **NASA's Kennedy Space Center** in Florida and **NASA's Ames Research Center** in California. NASA also released a draft strategy for continued exploration of Mars, outlining plans for robotic missions following the **Mars Sample Return** mission. **Canada** announced that its federal budget included $1.2 billion to create a **lunar utility vehicle**. The **Australian Space Agency** awarded grants for **Trailblazer Stage 1**, a program to design a lunar rover that can collect regolith and deliver it to a NASA in situ resource utilization facility. Japanese company **GITAI** used two rovers each equipped with dual robotic arms to demonstrate lunar base construction in a Californian desert environment that simulated the lunar surface.

Also in March, **NASA's Jet Propulsion Laboratory** and **Motiv Space Systems** of California published a journal article about their **Cold Operable Lunar Deployable Arm**, describing the development and testing for component and system technologies that would allow this robotic arm to operate in extremely cold environments, such as lunar nights. In April, Motiv announced its partnership with **PickNik Robotics** of Colorado to upgrade the **xLink** robotic arm to use **MoveIt Studio** software, aiming to create a more capable robotic manipulator for ISAM.

In June, **NASA's Cooperative Autonomous Distributed Robotic Explorers project** completed its first autonomous driving test with a model rover in **JPL's Mars Yard** in California. A trio of rovers are being built for a **Commercial Lunar Payload Services** lunar mission that aims to show how multiple autonomous robots can simultaneously take measurements across different locations. Additionally, the JPL-funded **Multi-Modal Mobility Morphobot project** published testing results. The M4 rover, led by professors at **Caltech** and **Northeastern University**, was designed with four articulatable wheels with embedded propellers, prototyping the next generation of rovers that could autonomously adapt to their terrain and circumvent obstacles by morphing modes of traversing, including driving, walking and flying.

In June, **Northrop Grumman's SpaceLogistics** sold its third **Mission Extension Pod** to **Intelsat**. This "jet pack" is attached to legacy satellites to provide propulsion. The pods will be installed by SpaceLogistics' **Mission Robotic Vehicle**, which is equipped with a pair of **DARPA's Robotic Servicing of Geosynchronous Satellites robotic arms** built by the **U.S. Naval Research Laboratory** in Washington. Researchers completed all component-level testing in November 2022.

In July, NASA announced a Tipping Point award to **Astrobotic Technology**. The Pennsylvania company is to land its Griffin lander to the moon to demonstrate robotic deployment of a power cable across the lunar surface with its CubeRover. NASA selected **Protoinnovations** of Pennsylvania to mature mobility control software for lunar robots and rovers. **Redwire** of Florida was selected to build lunar infrastructure, such as landing pads, using microwave emitters to heat and solidify regolith.

In August, the **Indian Space Research Organization's Vikram lander** touched down near the lunar south pole. The lander deployed the **Pragyan rover**, which in September completed its first motion and data collection tasks. ★

▼ NASA engineers this year conducted an egress test with the model of the agency's VIPER, short for Volatiles Investigating Polar Exploration Rover. The rover is scheduled for launch late next year aboard an Astrobotic Griffin lander. After the lander touches down at the lunar south pole, VIPER will have to descend at a height and angle similar to the setup in this picture.
NASA/Dominic Hart