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AEROSPACE

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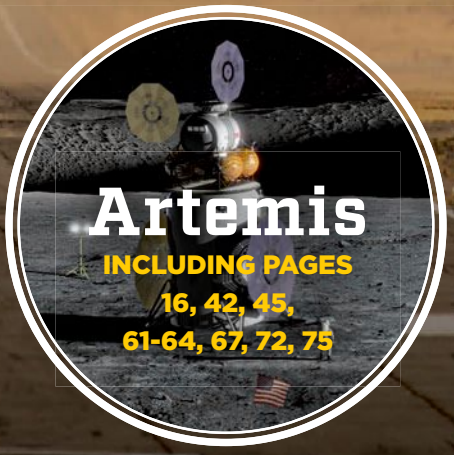
2019

YEAR IN REVIEW



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AIAA
SHAPING THE FUTURE OF AEROSPACE

A year of exploration and commercialization of space

BY BRIAN C. GUNTER

The **Astrodynamics Technical Committee** advances the science of trajectory determination, prediction and adjustment, and also spacecraft navigation and attitude determination.

▲ **A stack of 60 Starlink** satellites ready for launch. SpaceX has approval to launch about 12,000 global broadband satellites.
Starlink

The astrodynamics community was active in a number of exploratory and commercialization efforts this year, starting with NASA's **New Horizons** spacecraft's January flyby of **Ultima Thule**. Following the flyby of Pluto by New Horizons in 2015, the encounter with Ultima Thule, a binary Kuiper Belt object orbiting approximately 6.6 billion kilometers from the sun, represents the **most distant planetary body ever reached by a spacecraft** and returned valuable imagery and other data regarding these remote and ancient objects.

Exploration of the solar system continued with other notable achievements from ongoing deep-space missions, such as the close approaches to the sun by NASA's **Parker Solar Probe** (the third of which was in September) and multiple touchdowns and sample-collection maneuvers by the Japan Aerospace Exploration Agency's **Hyabusa2** mission at the **Ryugu** asteroid.

While not a deep-space mission, the crowd-funded **LightSail 2** mission developed by the California-based Planetary Society deployed its 32-square-meter solar sail in July and later verified that the satellite was able to raise its apogee by the solar radiation pressure on the sail. By demonstrating "flight by light" for cubesats, the mission has paved the way for future small satellites to explore the solar system without the use of traditional propulsion systems.

In June, the U.S. Air Force Research Laboratory launched **its Demonstration and Science Experiments, or DSX**, mission to study the radiation environment of near-Earth space. By July, the mission had unfurled its long antenna booms, including one pair measuring 80 m (262 feet) tip-to-tip, to become the largest uncrewed three-axis stabilized spacecraft ever flown.

In February, **OneWeb** moved closer to its goal of providing global internet services with the launch of its first six satellites. The satellites were raised to their final 1,200 km orbit and demonstrated data rates up to 400 megabytes per second. These satellites represent the first of an initial constellation of **650 satellites** that will ultimately grow to a total of 1,980 satellites. SpaceX reached a similar milestone in May when it launched the first 60 satellites of the Starlink constellation into orbit. **Starlink** seeks to also provide global broadband services with an approved constellation of nearly **12,000 satellites** in orbits ranging in altitude from 340 km to 1,150 km. In July, Amazon's **Kuiper Systems** proposed an additional broadband constellation of **3,236 satellites**, with all satellites targeting an altitude below 630 km. If all three "megaconstellations" reach full implementation, this would represent 17,000 new orbiting satellites, significantly increasing the number of objects in low Earth orbit and highlighting policy concerns regarding regulation of space activity and orbital debris.

The private utilization of space took another step forward when the **Beresheet** mission launched in February and attempted to land on the **lunar surface**. Israeli-based nonprofit **SpaceIL** developed the mission, and although the lander ultimately crashed during the final descent phase, it represented the first attempt by a private entity to land a payload on the moon. Another lunar milestone was achieved a few weeks earlier when **China's Chang'e-4** was the first to place a lander and rover on the far side of the moon in January. A separate effort by the Indian Space Research Organization to place the **Vikram lander** on the lunar surface was attempted in July, nearly coinciding with the 50th anniversary of the **Apollo** lunar landing. Communications were lost with the lander during the descent; however, the primary lunar orbiter, **Chandarayaan-2**, was fully operational as of November and was to proceed with its seven-year mission to study the composition of the lunar surface. These international attempts to return to the moon, complemented by NASA's Artemis lunar exploration program, show the global renewed interest in lunar research and exploration. ★