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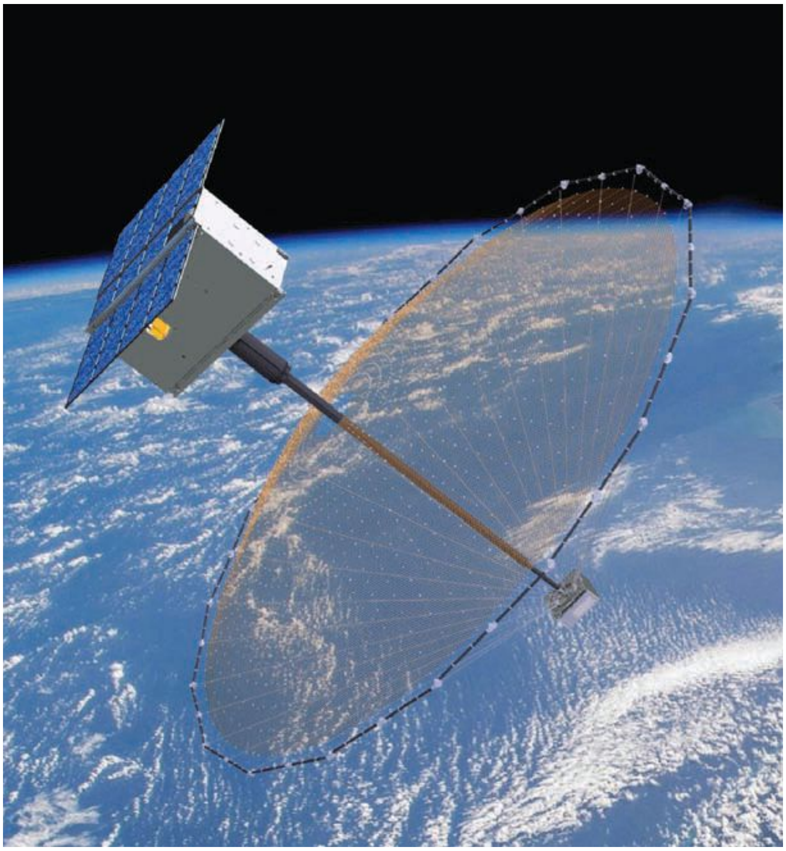
Deployable structures expand the capabilities of small satellites

BY MARK SILVER

The **Spacecraft Structures Technical Committee** focuses on the unique challenges associated with the design, analysis, fabrication and testing of spacecraft structures.



▲ **Artist's rendering of** L3Harris' 5-meter-diameter High Compaction Ratio antenna. The design scales from a 1-meter-diameter dish that fits into a cubesat volume to the 5-meter-diameter dish shown here, which in stowed form takes up one-tenth of a cubic meter, a fraction of a small-satellite volume.
L3Harris

As the role of small satellites in commercial, research and government missions continues to grow, deployable structures are further expanding their capabilities. New small satellite capabilities that deployable structures have enabled include high-gain antennas, accelerated deorbit and solar sail propulsion.

The year began with L3Harris Technologies of Florida introducing a new generation of high-accuracy, large-aperture small satellite antennas called the High Compaction Ratio, or HCR, reflector antenna. HCR ranges from a 1-meter reflector and feed that fits in a 20-by-10-by-10-centimeter volume suitable for cubesat applications, to a 5-m reflector that packages in less than a quarter of an Evolved Expendable Launch Vehicle Secondary Payload Adapter class satellite. The **HCR reflector antenna** is designed for high-frequency, high-gain performance of up to 40 gigahertz. It enables a fast production turnaround to support small satellite constellation development.

L3Harris Technologies also announced that it has begun constructing its 100th **deployable mesh reflector antenna**. This 12-meter-diameter folded rib reflector will be used in a European mission to measure biomass and carbon in forests around the world and is scheduled to launch in 2022. While this milestone is an important one for L3Harris, it is also an important milestone for the deployable structures community because it demonstrates how, with continuous development over the past 50 years, deployable spacecraft structures have become much more widely accepted by the greater satellite industry.

Elsewhere in the industry, in March DARPA launched MMA Design's 2.25 m-diameter **Pantograph Deployed High Gain Reflectarray**, or P-DaHGR, on the Radio Frequency Risk Reduction Deployment Demonstration satellite. P-DaHGR, developed and built at MMA's Colorado facility, offers high-performance, scalable RF capabilities, from UHF to Ka-band, that are specifically designed for small-satellite missions. The reflect array technology can provide equivalent to performance to more complex, parabolic-shaped dishes for missions that do not require large bandwidths.

The use of **high-strain composite deployable mechanisms**, which have thin composite materials that can be rolled or folded, continued to accelerate over the past year. In June, Roccor's HSC drag sail known as ROCFall was launched on the General Atomics Orbital Test Bed satellite. ROCFall, developed and built at Roccor's Colorado facility, will be used to deorbit the satellite at the conclusion of its operations in order to meet the 25-year low Earth orbit lifetime guidelines.

Also in June, the crowd-funded **LightSail-2** spacecraft from the Planetary Society was launched from NASA's Kennedy Space Center in Florida. LightSail-2 is a 32-square-meter solar sail that uses the energy of incident solar photons to provide a propulsive force. While solar sail propulsion was first demonstrated in 2010 by the Japan Aerospace Exploration Agency's IKAROS interplanetary mission, LightSail-2 is the first demonstration of solar sail propulsion in low Earth orbit.

In August, assembly of NASA's **James Webb Space Telescope** was completed at Northrop Grumman's California factory. The final assembly step involved joining the Spacecraft Element and Optical Telescope Element/Integrated Science Instrument Module or OTIS. Once additional tests are completed and Webb unfolds in space following its 2021 launch, it will be the largest space telescope and the first deployable space telescope. ★

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