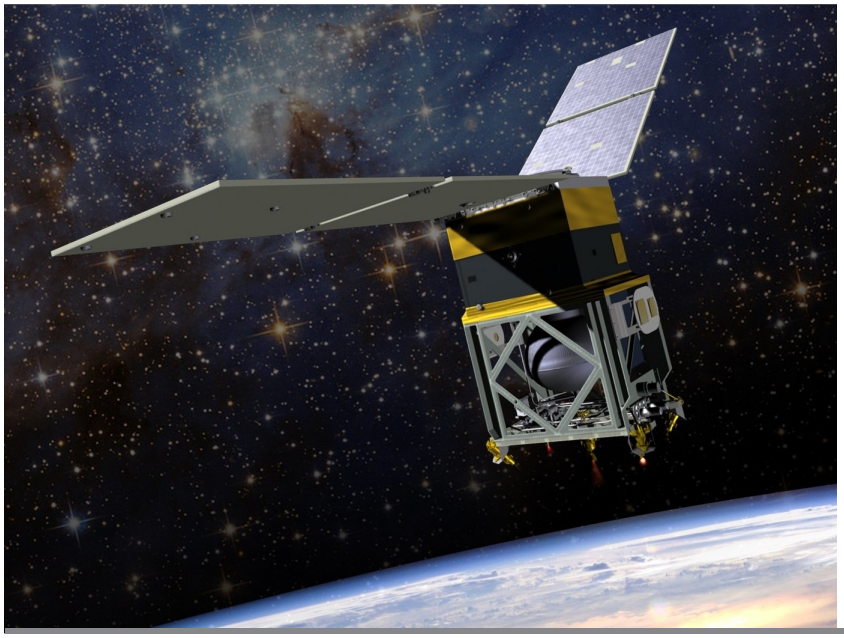


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Communications

Lightweight, Self-Deployable Helical Antenna

High data rate communications in a small form factor

SmallSats are experiencing increasing adoption in the satellite industry. While initially used primarily for technology demonstrations in low Earth orbit (LEO), enhanced capabilities have enabled SmallSat use for a broad number of applications. Today, sending small spacecraft beyond LEO to Lunar or deep space environments is attracting both scientific and commercial interest. Such missions are mass and volume constrained, yet must provide high data rate communications. Historically, patch antennas have been used for SmallSat communications. While new antenna technologies are in development, some are not optimized for size, mass, and performance - especially beyond LEO.

Engineers at NASA's Marshall Space Flight Center identified the need for a small form factor antenna to provide high data rate communications for such missions. In response, they developed a self-deployable helical antenna that is lightweight, low volume, and has low stowage thickness while delivering high data rate performance.

BENEFITS

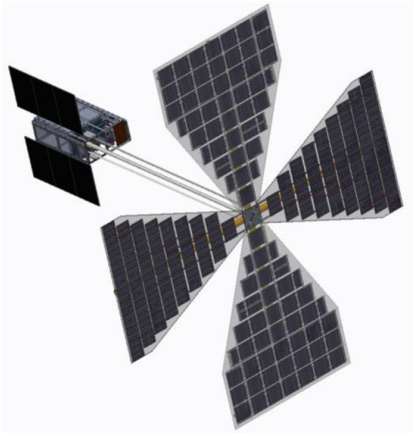
- Form factor & design: NASA’s helical antenna stows with much less volume than conventional helical and patch antennas, self-deploys to designed specifications, and still retains the advantages inherent to helical antennas available on the market.
- Reduced mass: In addition to low volume, NASA's self-deployable helical antenna is lightweight - offering mass conservation while still providing high data rate communications.
- Useful in array applications: In array implementations (e.g., 16x16), the invention delivers comparable performance in a package one-tenth the size and mass of traditional antenna arrays. Furthermore, the invention can be integrated into existing deployable structures (e.g., power generation arrays).

THE TECHNOLOGY

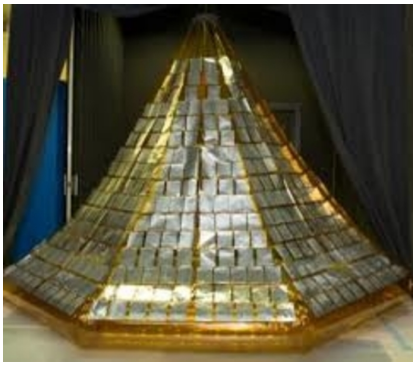
NASA's newly developed antenna is lightweight (at or below 2 grams), low volume (at or below 1.2 cm3), and low stowage thickness (approx. 0.7 mm), all while delivering high performance (at or above 10 dBi gain). The antenna includes a novel design-material combination in a helical coil conformation. The design allows the antenna to compress for stowage (e.g., satellite launch), then self-deploy at the desired time in orbit.

NASA's lightweight, self-deployable helical antenna can be integrated into a thin-film solar array (or other large deployable structures). Integrating antenna elements into deployable structures such as power generation arrays allows spacecraft designers to maximize the inherently limited resources (e.g., mass, volume, surface area) available in a small spacecraft. When used as a standalone (i.e., single antenna) setup, the the invention offers moderate advantages in terms of stowage thickness, volume, and mass. However, in applications that require antenna arrays, these advantages become multiplicative, resulting in the system offering the same or higher data rate performance while possessing a significantly reduced form factor.

Prototypes of NASA's self-deployable, helical antenna have been fabricated in S-band, X-band, and Ka-band, all of which exhibited high performance. The antenna may find application in SmallSat communications (in deep space and LEO), as well as cases where low mass and stowage volume are valued and high antenna gain is required.



NASA's lightweight, self-deployable helical antenna will be integrated into the Lightweight Integrated Solar Array and Transceiver (LISA-T) - a launch stowed, orbit-deployed array on which thin-film photovoltaic and antenna elements are embedded.



An image of a LISA-T test article at NASA's Marshall Space Flight Center.

APPLICATIONS

The technology has several potential applications:

- SmallSat communications: NASA's helical antenna provides high data rate communications in a deployable form factor suitable for SmallSats, as well as larger spacecraft. While the antenna (and arrays made thereof) may be particularly useful for deep space missions, it will likely also provide advantages to spacecraft in LEO.
- Military communications: Due to its low mass, low stowage volume, and high gain, NASA's helical antenna may be suitable for satellite-based military communications.

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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