Passively Stable Pyramid Sail for Small Satellite Deorbit (#7631)

A deployable drag device that ensures satellites deorbit within 25 years regardless of functionality

Georgia Tech researchers have developed a deployable drag device that leverages recent advancements in thin membrane deployable structures to create a passive aerodynamically stable drag sail that will ensure a satellite deorbits within 25 years regardless of its functionality. Upon initiation, four lenticular booms are deployed that unfold the sail into a square pyramid shape. The baseline design of the sail was set at an apex half-angle of 85 degrees, with 8 meter long booms to ensure that a 100 kg satellite will deorbit from a circular orbit at an altitude of 1,200 km within 25 years. Furthermore, the device is designed to be scalable and is capable of deorbiting 150 kg satellites from the same orbit altitude.

The drag device passively trims to a maximum drag attitude perpendicular to the flow direction. This stability, combined with a deployment timer, allows this deorbit system to be independent of the status of the satellite itself. It will be deployed after a pre-programmed time, and the system will include a standard interface to update the default deployment date if desired. This ensures that the satellite will be deorbited even if there is a mission-ending event, without the need for an active debris removal system.

Benefits/Advantages

- Aerodynamically stable
- Passively trims to the maximum drag altitude to accelerate reentry
- Effective for deorbit of satellites
- Does not require an active satellite to complete deorbit

Potential Commercial Applications

To meet the 25 year deorbit guideline, the passively stable pyramid sail device can be used by several commercial organizations, such as SpaceX and OneWeb. These organizations plan to launch large constellations consisting of thousands of small satellites to provide global internet service.

Background/Context for This Invention

Orbital debris has crossed a threshold of critical density in Low Earth Orbit where the number of debris objects will grow exponentially due to collisions unless actively mitigated. Recent announcements of commercial small satellite constellations indicate interest in deploying hundreds to thousands of micro-satellites into Low-Earth Orbit at altitudes ranging from 1,000-1,200 km, in order to provide global internet service. These constellations create a great need for a standard system for deorbit to help mitigate the orbital debris problem.
For more information about this technology, please visit:
https://industry.gatech.edu/technology/passively-stable-pyramid-sail-small-satellite-deorbit