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CONSIDERATIONS FOR SATELLITE CONSTELLATION DEPLOYMENT VIA MOMENTUM EXCHANGE TETHERS

Abstract

In recent years, concepts for satellite constellations have been a heavily discussed topic. For the aerospace community as a whole however, establishing new satellite constellations using traditional practices can be costly, require a long time to perform, and be logistically difficult to accomplish. Most existing satellite constellations have been established using methods involving either multiple independent launches of member satellites, the inclusion of advanced propulsion systems aboard ride-sharing satellites capable of providing significant V to increase spread, or a combination of the two. One approach that could enable the aerospace industry to more easily execute missions involving constellations could be to implement rotating momentum exchange tether (MET) deployment systems, which would be used to rapidly deploy ride-sharing satellites into their own orbits shortly after launch to support the constellation.

This use of a centrifugal release system to dispense satellites can allow for V to be imparted nearly instantaneously, rather than waiting for propulsion system burns to be completed. On satellites, traditional propulsion systems are typically chemical or electrical, which require propellant and can take significant time to properly disperse. Early modeling of constellations deployed using MET-based techniques have been able to achieve full dispersion on the order of days or weeks, as opposed to months or years like other proposed or existing constellations. In general, this approach could enable rapid deployment of satellite constellations in Earth orbits, or also be an accelerator in developing the infrastructure needed in establishing human settlements at locations such as the Moon or Mars.

Current research has been conducted evaluating the primary governing parameters and relations involved in designing, establishing, and maintaining MET-deployed constellations, in a manner which attempts to determine the best practices in support of spacecraft of all scales, quantities, locations, and applications. In addition to these conceptual studies, plans are currently underway to demonstrate this concept in the space environment. A low-risk suborbital technology demonstration mission, currently under the name ADRASTEA, is being developed and planned to be flown on a sounding rocket with NASA for a short-duration space flight. This mission will test an approximately 1.5-U CubeSat scale test unit and four even smaller onboard deployable payload units in sequences demonstrating controlled tether and payload deployment, rotation, release, and tracking. New MET technologies and operations are currently being developed for this mission, and will provide a technical basis for more rapid deployment of advanced future satellite constellation systems.