IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IP)

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TETHER BASED PROPULSION - LOW HANGING FRUIT

Abstract

Tether based propulsion is a complex task with difficulties somewhat analogous to sailing into the wind.

There are some simple tether launching methods achievable by producing torque which can be used to position tether ends in compatible and thereby stable orbits. The simplest orbit configuration is the tidally locked state. This state will apply tension to the orbiting tether, which accelerates the upper end by dragging back the lower end.

The same launching method can induce any desirable rotation the device is capable of. Rotational modes synchronous to the orbit frequency produce cycloidal trajectories, asynchronous modes precess and the enlargement or contraction of the tether rotational sweep bears a relationship with lemniscates and other geometry formed by linear polar tracings of simpler forms.

Another configuration that can be entered is a mirrored pair of oblique eccentric orbits, which maintain a fixed orientation of the tether relative to the greater orbital system (heliocentric). These orbits can be established to impart very little tension to the tether, while maintaining the sun-facing orientation, which would be a desirable state for large solar arrays.

Propulsive interactions can be achieved with tether based propulsion systems. A simple orbital bounce network could suspend a slower body, possibly to the point of being geostationary. Contactless interactions would be required to impart forces when relative velocities are beyond what could be controlled with physical contact. Electrodynamic tethers are ideal for such purposes because the impulse of acceleration can be managed over long durations and distances.

While it may have been envisaged to use a Landis Slingshot to collect and deliver payloads to and from orbit, the intuitive application of such a tether system to decelerate the lower tip to sub orbital velocities still leaves the problem of adding or withdrawing payload orbital energy.

Enabling this method of orbiting and de-orbiting payloads requires a device capable of also producing orbital energy if we are to hammer the rocket equation down to a more manageable problem.

The Cosmic Yoyo is designed to enable such actions, however, resolving how such actions are to be executed will require a more detailed analysis, particularly the procedure for accelerating payloads traversing slow suborbital trajectories and how a network of tether propulsion systems could progressively orbit and de-orbit payloads.

Having a solution to Kepler's Time Equation would make such analysis and simulation significantly easier.