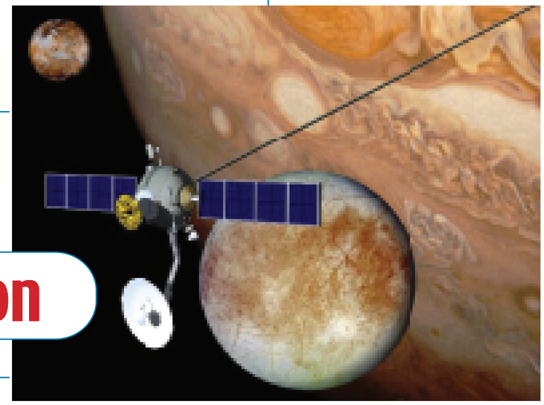
Advanced Space Transportation Technology Summary



Electrodynamic Tether Propulsion

Tether-based propulsion draws power from the near-Earth space environment, allowing the transfer of energy and momentum from one object to another. This cheap, efficient and reusable alternate propulsion source has the potential to turn orbiting, in-space tethers into "space tugboats" – replacing heavy, costly, traditional chemical propulsion and enabling a variety of missions along the highway to space.

Electrodynamic tether propulsion is now being developed by NASA's Marshall Space Flight Center in Huntsville, Ala., and its partners in industry and academia.

An electrodynamic tether – basically a long, thin wire deployed from an orbiting satellite or vehicle – uses the same principles as electric motors in many household appliances and automobile generators. When a wire moves through a magnetic field, an electrical current results. As this current flows through the wire, it experiences a push from any external magnetic field – such as that found naturally around the Earth. The force exerted on the tether by the magnetic field can be used to raise or lower a satellite's orbit, depending on the direction of the current's flow.

Electrodynamic tethers used for propulsion in low-Earth orbit and beyond could significantly reduce the weight of upper-stage rockets used to boost spacecraft to higher orbit. And because they require no propellant, electrodynamic tethers substantially reduce spacecraft weight, providing a cheap, efficient method of reboosting the orbits of spacecraft, and potentially, the International Space Station.

Researchers at the Marshall Center also are investigating the use of electrodynamic tethers to extend and enhance future scientific missions to Jupiter and its moons. In theory, electrodynamic tether propulsion could be used near any planet with a significant magnetosphere, such as the enormous one found around Jupiter.

Previous visits to the largest planet in the solar system – including the "Grand Tour" flyby missions of Voyager 1 and 2, launched in 1977, and an orbital visit by the Galileo probe, which left Earth in 1989 and continues to tour and study the Jovian system today – were illuminating, but the fuel limitations and minimal maneuverability of those probes hampers long-term, more detailed scientific study. Development of a propellant-free, electrodynamic tether propulsion system would make it possible to put a long-term probe in Jupiter's orbit – one that could leverage the planet's powerful magnetic field and magnetosphere to travel freely among the Jovian moons, providing new insight about them as well.

Flight demonstration of an electrodynamic tether propulsion system is scheduled for June 2002. The Propulsive Small Expendable Deployer System, or ProSEDS, will fly aboard a Delta II rocket launched from Kennedy Space Center, Fla. Once in orbit, the ProSEDS experiment will demonstrate an electrodynamic tether's ability to generate significant thrust in space by decreasing the orbit of the Delta II second stage.

ProSEDS will deploy a 3.1-mile (5 kilometers), bare-wire tether connected with a 6.2-mile (10 kilometers) non-conducting tether from the Delta II second stage to lower its orbit. Performance measurements will be collected and transmitted to the ground from the time of deployment until the experiment concludes a few days later.

NASA's industry team for the ProSEDS experiment includes: Tether Applications Inc. of Chula Vista, Calif.; Electric Propulsion Laboratory of Monument, Colo.; Triton Systems Inc. of Chelmsford, Mass.; Smithsonian Astrophysical Observatory of Cambridge, Mass.; Alpha Technologies of Huntsville; the University of Michigan in Ann Arbor; and Cortland Cable in Cortland, N.Y.

For more information about space tethers and their potential applications, visit:
http://www.tethers.com
For more information about NASA Space Transportation Systems, visit:
http://www.spacetransportation.com

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