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AN UPDATE ON EDDE, THE ELECTRODYNAMIC DELIVERY EXPRESS

Abstract

"EDDE" (the ElectroDynamic Delivery Express) is a new kind of non-rocket space vehicle. It is solar-powered, propellantless, and persistently maneuverable throughout low Earth orbit. EDDE consists mostly of a reinforced aluminum foil tape to collect and conduct electrons, plus solar arrays to drive this current. Hot wires emit electrons back into the ambient plasma. Tape current crossing the geomagnetic field causes the maneuver force, and the ambient plasma closing the current loop sees an opposite force. EDDE slowly rotates end-over-end to stiffen itself. This allows sustained high thrust without dynamic instability. Rotation also improves agility, by allowing a wider range of thrust directions normal to both tape and magnetic field. EDDE is modular and typically weighs 30 to 80 kg. Air drag sets a minimum altitude near ISS (350-420 km). There is no hard ceiling, but thrust decreases with plasma density at high altitude. EDDE's first application may be distributing secondary payloads far from a primary payload's orbit, allowing custom orbits without dedicated launch. EDDE's total orbit change capability far exceeds that needed for any single orbit change in LEO. After distributing payloads, EDDE can inspect failed satellites in multiple orbits, to image impact features and other visible anomalies. With suitable capture interfaces, EDDE might capture satellite service vehicles, so they can service far more LEO satellites without running out of propellant. This makes EDDE a "LEO taxi" that customers can rent rather than buy. EDDE can also rendezvous with and capture ton-class orbital debris in nets. It can then drag it down to short-lived orbits below ISS, or collect it in tethered assemblies at less congested altitudes, for later recycling and/or deorbit. This paper describes EDDE design, components, and operations, novel missions that EDDE enables, and our flight test plans, including NRL's TEPCE cubesat experiment.