Paper ID: 62032
student

Space Transportation (6)
Space Transportation (1) (1)

Author: Dr. Martin Kolar
Brno University of Technology, Czech Republic

GRAVITY WELL PUMP

Abstract

Rockets provide the only proven way of lifting material permanently up the gravity well. Suggested improvements upon the inefficiencies of rockets rely on materials which don't exist (ex.: Space Elevator), building at currently infeasible scale (ex.: Mass driver), or partial use of rockets (ex.: Skyhook).

The proposed method relies on the application of tested knowledge, combined in a novel manner. A projectile is shot into space, intercepted by a LEO satellite, and momentum is accrued with ion engines. This space pump, when lifting 10 kg per orbit, allows bringing 58 tons of material to orbit each year. The estimated running cost is 100 times less than reusable rockets, at 20 $ per kg, and the development cost is comparable to standard satellite deployments.

Since materials undergo over 14 000 g, the pump cannot be used for fragile cargo.

1 Method

A projectile is packed with useful cargo, and the shell is designed to allow re-use. This package is fired to intercept with the orbital element, at 150 km altitude. Such a firing has been practically demonstrated in project HARP in 1966.

The package is then intercepted on a hook on the end of a 500 m long wire, 'hanging' from the orbital element. The relative velocity is 7 km/s. Commercially available Dyneema R rope can withstand the pull, and allows quick hauling in of the package. The necessary interception precision is achievable with existing Anti-satellite weapons (ASAT) technology.

The orbital element regains its orbital velocity using ion thursters, powered by electricity from solar panels. The momentum lost to impact with the projectile and atmospheric drag are made up for over the course of one orbit, as demonstrated by project GOCE.

A small prototype system can handle one 10 kg projectile on each orbit. The technique can be used to deliver materials to a space port in LEO, from where it can be raised via ion thursters alone.