SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
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LUNAR BASED MASS DRIVER APPLICATIONS

Abstract

A mass driver is an acceleration device, which utilizes electromagnetic forces to propel a payload. Two main mass driver concepts need to be distinguished: the coil or Gauss gun [1], which uses the electromagnetic fields of a series of coaxially aligned coils and the rail gun [2] where a payload slides between two conducting rails. The Moon as a celestial body in the vicinity of Earth offers two main benefits for the placement of such a facility: lack of relevant atmosphere and comparable low escape velocity. Therefore it is an ideal candidate for use of a mass driver for easy and low cost access to space to enable various space flight activities, especially in the influence sphere of Earth. Furthermore the composition of lunar soil [3] suggests the construction of infrastructure by utilizing in-situ materials.
It is assumed that in the midterm launches from the lunar surface to Earth orbit and surface will become significant.
Satellites, spacecrafts or heavy component thereof, space station components and consumables can be processed and manufactured on the Moon and then be launched at low costs into Earth orbit for further use. Rare materials (like He3) extracted on the Moon can be brought back to Earth for scientific or commercial applications.
A trajectory analysis to determine coordinates on the lunar surface for optimal minimum energy flight opportunities from Moon to Earth resulted in multiple possible locations. As some of the expected payloads (scientific instruments, material samples, satellites, crewed spacecraft) are only be able to sustain moderate acceleration forces the dimensions (length) of the accelerating facility increases dramatically. Therefore the overwhelming part of a mass driver will be manufactured from lunar material. A large mass driver with moderate acceleration, can also be used for sturdier payloads and therefore higher accelerations to explore interplanetary space up to the Oort Cloud.
Processing plants to prepare lunar soil and manufacture needed components are the decisive cost factor to evaluate the feasibility of a mass driver on the Moon. A first order estimation for various mass driver concepts is presented for a selection of payloads.
Additional factors like maintenance requirements, reliability, safety, scalability and adaptability are considered and evaluated.

[1] Birkeland: Electromagnetic gun, US 754637 A, 1904

[2] Fauchon-Villeplee, Octave: Electric Apparatus for Propelling Projectiles, US Patent 1,421,435 ,1922

[3] Heiken, Vanniman, French: Lunar Sourcebook, Chap. 5 Lunar Minerals p.121 ff, Cambridge University Press, 1991