THE LUNAR SPACE ELEVATOR, A NEAR TERM MEANS TO REDUCE COST OF LUANR ACESS

Charles F Radley, Leeward Space Foundation, Inc., 572 Burlington Ave Ne, Palm Bay, Florida, 32907, USA, email: CFRJLR@gmail.com

Introduction: A Lunar Space Elevator [LSE] can be built today from existing commercial polymers; manufactured, launched and deployed for less than $2B. A prototype weighing 48 tons with 100 kg payload can be launched by 3 Falcon-Heavy's, and will pay for itself in 53 sample return cycles within one month. It reduces the cost of soft landing on the Moon at least threefold, and sample return cost at least ninefold. Many benefits would arise. A near side LSE can enable valuable science mission, as well as mine valuable resources and ship to market in cislunar space, LEO and Earth's surface. A far-side LSE can facilitate construction and operation of a super sensitive radio astronomy facility shielded from terrestrial interference by the Moon. The LSE would facilitate substantial acceleration of human expansion beyond LEO.

Overview: The original idea for a Space Elevator was for an elevator from the surface of the Earth up to Geostationary orbit. This idea is attractive since in theory it could greatly reduce the cost of access to space 1,2, however, there are no materials existing or on the horizon which are remotely strong enough to hold their own weight over the distance in the Earth's gravity field. Theoretically Single-Walled Carbon Nanotubes [SWCNTs] would suffice3, but nobody can manufacture them longer than a few cm. Furthermore, SWCNTs have only been produced in tiny quantities in laboratories, and there is no prospect of industrial scale production happening in the foreseeable future. However, there is another planetary scale tether concept which is almost as valuable, and can be built with existing industrial materials, and that is the LSE.

A LSE is a very long tether, connecting the surface of the Moon to an Earth Moon Lagrange [EML] point, either EML1, between Earth and Moon (nearside), or EML2, behind the Moon as vie wed from the Earth (farside). In order for the LSE system to be stationary with respect to the Moon it is necessary that the center of mass of the LSE be located at an EML point. Therefore, the tether must extend further from the lunar surface than the EML point, and be terminated at a counterweight. The Moon orbits the Earth, the LSE is not stationary with respect to the Earth.

In a design by T. M. Eubanks the total length of a nearside elevator is 278,544 km, and the total length of the farside elevator is 297,308 km 5.

On average, EML1 is 326,380 km from Earth and 58,019 km from the Moon. EML2 is 448,914 km from Earth and 64,515 km from the Moon. Hence, in the Eubanks design, the distance from the Lagrange point to the counterweight for the EML1 system is 220,525 km and for the EML2 system is 232,793 km .

These distances are unprecedented in aerospace engineering, yet preliminary analysis indicates it is both possible, and affordable, using with existing commercial materials5. In this paper we will show how the lunar elevator is both feasible and affordable, and indeed profitable. Of course, there will be many technical and engineering challenges, but as far as we know today, there are no obvious showstoppers.

The idea of a lunar elevator is not new. The first known writing, where the concept of a lunar elevator was described by Tsander in 1910. Star Technology Inc. studied the LSE concept, for NASA Institute of Advanced Concepts in 2005[4].

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