Paper ID: 88608
interactive

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IP)

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A STUDY INTO THE EFFECTIVENESS OF A GROUND-BASED ELECTROMAGNETIC LAUNCHER FOR THE PURPOSES OF DEVELOPMENT OF A TECHNOLOGY DEMONSTRATOR

Abstract

Over the past half century, space launches have become increasingly in demand. Very few countries such as The United States, Russia and China have developed National Space Programs capable of launching spacecraft into orbit. There are also very few large successful private sector players developing launch capacity such as SpaceX. Current orbital delivery costs can reach $10K/kg.

This is in large part due to the need for a lot of propellant in staged chemical rocket systems which accounts for between 90 to 96% of the total weight of the rocket. This is also because most of the chemical rocket systems are not re-usable. The only operational reusable orbital-class launch systems are the Falcon 9 and Falcon Heavy from SpaceX, the latter of which is based upon the Falcon 9. This project offers a new idea of lowering the cost of delivering a 1Kg payload into orbit. A ground based electromagnetic accelerator system to provide a launch-to-orbit capability offering a reduction in launch costs compared with current large chemical boosters. This method can accelerate vehicles to velocities from 2km/s of the propellant-based launch method to 5 km/s from the ground, it could reach a maximum height of approximately 1,200 km because the force density of an electromagnetic field is much higher than that of the gas-pressure-induced force of chemical propulsion. The main merit of this system is its low cost. The launch of a 10-kg projectile using a ground-based electromagnetic system only requires 30 kWh of electricity. In Kenya the cost per kWh of an industrial consumer is a maximum of $ 0.066 per kWh for Commercial, 132 kV consumers and as low as USD 0.033 per kWh during off-peak hours, this translates to less than $100/kg in total costs.

In comparison, the cost of a typical chemical propulsion-based orbital launcher is approximately $10,000/kg. Moreover, the system can be reused for an unlimited number of launches, launching as many as 10 missions per minute. The proposed ground-based launch system would augment the chemical boost capability for a single stage to-low earth-orbit system (SSTO), with the initial velocity being provided electromagnetically by an external DC power source and the orbit insertion using a throttleable chemical Rocket Engine on the spacecraft. A reusable Scramjet-Air breathing engine integrated on the Orbiter vehicle will accelerate the Spacecraft in the thicker parts of the atmosphere at hypersonic velocities Mach 5 to low-Earth orbit (LEO).