Contribution ID: **45** Type: **Oral**

Pulsed Power Considerations Relating to EM Space Launch

Wednesday 21 June 2017 17:00 (15 minutes)

Recent studies have evaluated whether a ground-based electromagnetic (EM) acceleration system could provide a useful reduction in launch-to-orbit costs compared with the large chemical boosters currently used. Potential advantages of the EM launch approach include increased launch frequency, safety and reliability as well as cost reductions. There is a growing market for launch of small satellites that are commonly referred to as nanosatellites or microsatellites, especially, but not exclusively, for missions in low Earth orbit (LEO). The most common systems presently being studied are based on cubesats which may operate in multi-satellite constellations; each individual cubesat typically has a mass of a few kilograms. The study reported here has evaluated the launch of a two-stage-to-low-Earth-orbit projectile, with the initial velocity being provided electromagnetically using a railgun and the orbit insertion via a rocket motor in a second stage that would carry the payload into low-Earth orbit.

Electromagnetic launch systems of this type will be governed by the same fundamental principles as tactical railguns but a major difference is that the EM accelerator track—which may be tens or hundreds of meters in length—cannot be powered only from the "breech"as in a tactical railgun, since electrical resistive losses will become unacceptably large. To overcome this, a distributed energy feed system (DES) is required.

One of the major differences between EM launch and present rocket launch systems is the acceleration load that the payload will have to tolerate. Present cubesats and similar satellites are designed only to tolerate accelerations of a few Gees, as encountered in conventional rockets. In contrast, as tactical railgun designs show, the EM launcher is capable of very high accelerations. The development of future novel pulsed power concepts and/or low-cost manufacturing approaches could help the EM system to become economically attractive and options for such approaches are discussed.

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Session Classification: Oral session 16 - Solid State Modulators and Pulsed Magnets for Accelerators, Electromagnetic Launchers - Session Chair : Michael John Barnes

Track Classification: Pulsed Power Industrial and Bio-Medical Applications