IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Interactive Presentations - IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (IP)

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AN INTEGRATED SOFTWARE DEFINED RADIO AND BEAM-TRACKING ANTENNA FOR LAUNCH VEHICLES

Abstract

Increasing range and throughput of communication links is a challenge for small launch vehicles. Traditional satellites have the capacity to utilize high gain, parabolic antennas however, these antennas have steering constraints, can cause thermal and mechanical problems if placed on the vehicle's surface and further lead to restricted look angles if placed in the vehicle. More traditional launch vehicles may utilize multiple omnidirectional antennas where the entire system directly powers the antenna pointed at relay satellites or ground stations, however, these systems are inherently limited by transceiver power and low antenna gain to achieve high data rates. As such, this paper presents a review of the state of launch vehicle communication systems. It then presents a detailed approach for a reliable and highly integrated Software-Defined-Radio (SDR) and beamforming antenna design, using a state-of-the-art Radio Frequency (RF) transceiver to provide high throughput multi-band applications on launch vehicles. Finally, Systems Tool Kit (STK) link budget simulations show that integrating the developed beam tracking communications system with an upcoming commercial space data-relay system, having an Equivalent Isotropic Radiated Power (EIRP) and gain-to-noise-temperature (G/T) of 41.5 dBW and 4.7 dB/K, results in transmission and reception rates of up to 1000 Kbps and 1 Kbps respectively from launchpad to low earth orbit.