IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

Author: Dr. David Gschliesser
Austrian Space Forum, Austria

Dr. Daniel Valtiner
Austrian Space Forum, Austria

ORBITAL ACCELERATOR: ENERGY SAVING INFRASTRUCTURE FOR INTERPLANETARY SPACE TRAVEL

Abstract

Future large-scale lunar or Martian stations will develop a need for frequent low-cost transportation of materials and humans in both directions, potentially orders of magnitude compared to contemporary space flight activities. When launching from Earth's surface, more than 90% of the launch energy required for reaching orbit is consumed by gaining horizontal velocity, and only a fraction to overcome the gravitational potential and losses caused by air friction. We introduce a concept called Orbital Accelerator (OA), an electromagnetic accelerator in low earth orbit. The OA is an orbiting rail mega-structure for a catching system (CS) translating along this rail with up to 7.9 km per second. Using this moving mechanism, the CS can catch rockets arriving from Earth and adding delta-v, provided by local energy storage. Secondly, the CS decelerates incoming payloads from higher orbits and stores their kinetic energy into this storage device. A combination of two of those systems (e.g. one in LEO, the other one in a low moon orbit) could potentially lead to a dramatic reduction in the energy required for interplanetary mass transport. Our paper describes the basic system architecture and projects first order-of-magnitude calculations for the dimensioning. Based upon classical orbital dynamics, we derive a basic system design and subsystems required. Interestingly we found a set of reasonable parameters, validating the feasibility despite the significant efforts required for establishing such a mega-structure. We propose multiple operational modes with different assumptions on dimensioning and potential use cases of an OA. Further, we systematically compare it with alternative space launch concepts. Last, we discuss technological and economical limitations of the OA concept.