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LOOPED PARTIAL SPACE ELEVATOR WITH MULTIPLE CLIMBERS – CONCEPT STUDY

Abstract

This paper proposes a novel concept of a looped parallel partial space elevator (LPSE) with multiple climbers for payload transportation in orbits. A single partial space elevator experiences the Coriolis forces induced by the moving climbers on the tether in the process of payload transportation due to, which may tumble the partial space elevator in space. The LPSE is developed to counterbalance the Coriolis forces formed by two parallel partial space elevators that are connected at two ends to form a looped tether transportation system. Each elevator could have multiple climbers with self-powered thruster to transfer payloads up and down along the tether. When the climbers moving up on tether and moving down on another tether in a looped motion, the Coriolis forces of moving climbers on each tether can work against each other to keep the partial space elevator stable in space. The concept is analyzed by a high-fidelity and high-accuracy model that is based on the nodal position finite element method in the arbitrary Lagrangian-Eulerian description. The simulation results show the LPSE concept is feasible. The trajectories of moving climbers on each tether can be properly designed to (i) minimize the effect of Coriolis forces, (ii) reduce the the libration motion of each tether and the LPSE as a system.