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Author: Dr. Andrew Meulenberg
Universiti Sains Malaysia, Malaysia, mules333@gmail.com

COMPRESSIVE MEMBERS FOR A SPACE ELEVATOR TO LEO

Abstract

A major impediment to getting man into space is cost: financial and environmental. Space elevators, of various design, have been proposed as an option to overcome the limitations of present rocket-based technology. However, all systems proposed have their own limitations. To overcome many of these problems, we propose a Low-Earth-Orbit system, a version of rotovator-based space-elevator systems called "sling-on-a-ring." This mass-lifting system would utilize the spatial stability, momentum-transfer capability, and electrical power-generation, -storage, and -transfer ability of an accessorized orbital ring. The system would consist of a high-tensile-strength equatorial circum-terra fiber (colossal-carbon tube, CCT, fiber), associated solar-power and station-keeping units, and rotating sling modules. Long sling assemblies (e.g., 600 km) would periodically descend into the atmosphere (to 13 km). The system would be adjusted so that at perigee, when the sling penetrates into the atmosphere, the rotational tip velocity of the sling end would almost cancel out the orbital velocity of the circum-terra ring relative to the earth's surface. With split-second timing, the payload (in the 10 ton range) would be attached from an ordinary aircraft and would be jerked vertically into space by the momentum of the sling. It is intended to establish that, with the demonstrated capabilities of materials presently under development, the proposed system would eliminate a need for the immense mass in space required for other space-elevator systems and for the hypersonic aircraft required by the HASTOL system. Furthermore, design and implementation of the system could be initiated immediately.

A few recognized limitations of the Sling-on-a Ring system are addressed: in particular, the need for very long (100km?), high-compressive-strength, low-density, deployable, stable structures are addressed with modular units based on an improved version of Tensegrity technology. The ability to compactly 'package' the components for transport to, and automated deployment in, space is critical. The improvements in the Tensegrity design for greater compressive stability (or for controlled stability) is critical to the application. The mathematics and design criteria to achieve this stability are included in the paper.