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Conceptualizing Space Elevators and Tethered Satellites (3)

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LINEAR DIRECT DRIVE MOTOR MECHANISM FOR USE IN TETHERED SATELLITES

Abstract

Linear Direct Drive Motor Mechanism for Use in Tethered Satellites Device that moves along a tether, i.e. Climber is very useful in the expanding field of Tethered Satellites. Previously, the Friction Roller Drive has been studied as a moving mechanism for Climbers. In this mechanism, a roller is driven by a motor's rotation, and presses against the tether to generate the locomotive force. The merit of using a friction roller drive system is in the high propulsive force that can be achieved. Currently, the friction roller drive system is being incorporated into a space experiment project currently under development. However, there are many points that need to be addressed in order for this type of system to be a viable option. One example is in the damage this system causes to the tether. The high contact pressure applied by a friction roller drive mechanism is harmful to the tether. This is no small problem for use in Tethered Satellites, which must maintain stable operation over a long period of time. There are also issues which arise from the nature of the space environment. High levels of radiation can cause deterioration in the surface material of the roller, extremely low pressure causes contact surfaces that undergo frictional wear to lose contaminations such as oxide layers, resulting in high stresses and perhaps even cold welding. Furthermore, with friction drive systems there is the chance of slippage occuring, not only making control difficult, but also causing the Tethered Satellite to become unstable, which is the worst possible outcome for these systems to which stability is everything. Instead, by utilizing a linear direct drive motor which applies force directly to the tether, there is no large pressure exerted as in the friction drive system, which results in a decrease in damage to the tether. As this will allow for a decrease in components which make up the climber, we can predict that the reliability and controlability of the system may be drastically improved. This is advantageous for the long-term stable operation of Tethered Satellites. Thus, this study implements a conductive tether along with a linear motor for the propulsive aspect of the climber used in a 50cm class microsatellite system; and we examine the feasibility of using a direct drive system such as this by comparing numerical analysis results along with 3D electromagnetic field analysis results.