

Stability Analysis of a Tethered System

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Space-tethers are very slender and flexible structures that are deployed in space. One of such structures is the SET (Short Electrodynamic Tether). The distinguishing characteristic of the SET is that it orbits with the longitudinal axis normal to the orbit plane. The SET is in continuous rotation about this same axis, which allows it to maintain the aforementioned operating position. The SET is not perfectly straight after deployment. This fact could make the system structurally unstable, as predicted by the linear study of unbalanced rotors when hysteretic damping appears in the shaft (supercritical velocities). However, if non-linear elastic and internal damping forces are considered in the model, the resulting motion of the structure could remain bounded. This assertion was shown in a previous study by the authors using multibody dynamic simulations. In order to confirm these results, the present work studies the stability of the SET's solutions analytically. A modified Jeffcott model will be the object of this study.

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