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REMOVING ENERGY FROM A SPACECRAFT USING TETHERS

Abstract

Removing energy from a spacecraft is sometimes necessary to decelerate it and, consequently, placing it in a desired orbit or to be capture by a celestial body. The use of tethers is an interesting strategy and, depending on how this maneuver is done, can result in a significant fuel economy for the mission. Maneuvers using a celestial body gravity field and impulses were studied with this goal, showing the best configurations for the removal of energy [1]. The strategy of using a tethered slingshot to maneuver a spacecraft in space has also been used and it is the basis of this work [2,3]. The strategy is to use a tether with one end attached to the celestial body and the other one receives the spacecraft. Then, the spacecraft will rotate and use the slingshot effect to achieve the desired deceleration. The focus is to analyze the resulting configurations in energy loss of the spacecraft from this maneuver. This analysis includes a verification to see if the spacecraft was capture or collided with the surface of the body. The study will not include tether allocation analysis on the surface of the celestial body and will be applied to some examples of celestial bodies.

References

[1] Ferreira, A. F. S., Prado, A. F. B. A., Winter, O. C., "Planar powered Swing-By maneuver to brake a spacecraft." Computational and Applied Mathematics. Vol. 37, Supplement 1, 2018, pp. 202-219. (doi:10.1007/s40314-017-0483-4). [2] Penzo, P. A. and Mayer, H. L., "Tethers and Asteroids for Artificial Gravity assist in the Solar System." Journal of Spacecraft and Rockets. Vol. 23, No 1, 1986, pp. 79- 82. (doi:10.2514/3.25086). [3] Prado, A.F.B.A. "Using Tethered Gravity Assisted Maneuvers for Planetary Capture." Journal of Guidance, Control and Dynamics. Vol 38, No. 9, 2015, pp. 1852-1856. (doi/abs/10.2514/1.G001009).