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Lunar Orbits: Short and Long-Duration Paths for Different Mission Objectives

Carvalho, Jean Paulo S.[1], **Casanova, Daniel**[2], **Tresaco, Eva**[3]

SUMMARY

Several nations are planning to return to the Moon to establish lunar bases and explore this celestial body, as exemplified by the Artemis Program. In this study, we analyze regions around the Moon that could support long and short-duration orbits. Short-duration orbits can be utilized for the removal of space debris, while long-duration orbits can be utilized for stable satellite operations and prolonged scientific missions.

In this work, we consider the motion of an orbiter around the Moon under its gravitational force perturbed by the third body attraction due to the Sun and the Earth, and the solar radiation pressure (SRP) without shadowing effect. We conducted an analytical study, applying Lagranges planetary equations, which provide the time evolution of the classical orbital elements for a disturbing potential. This allowed us to first identify frozen conditions, enabling the determination of pairs of semi-major axes and inclinations, which are advantageous for stability purposes (cf. [1]). Conversely, we explored resonant conditions caused by the combined effect of Moon's oblateness and solar radiation pressure to determine resonant corridors (cf. [2]), which are useful for determining initial conditions that either amplify or mitigate eccentricity increases. The analysis conducted in this study contributes to enhancing orbital decay processes or promoting orbital stability.

Keywords: Moon, Space Debris, Frozen, Resonant.

AMS Classification: 70F15, 70M20, 70H03

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[1]UFRB-Centro de Ciência e Tecnologia em Energia e Sustentabilidade
Universidade Federal do Recôncavo da Bahia. Brazil.

[2]Centro Universitario de la Defensa - Zaragoza. Spain.
IUMA - Universidad de Zaragoza. Spain.
email: casanov@unizar.es

[3]Dpt. Matemtica Aplicada and IUMA
Universidad de Zaragoza. Spain.