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# IMPACT OF THE VARIATION IN THE MODELLING OF A BINARY ASTEROID SYSTEM ON THE RESTRICTED FULL THREE BODY PROBLEM

**Abstract**

Missions to asteroids are an important part of space exploration. Approximately 16 % of the Near-Earth Asteroids (NEA) are known to be binary asteroids, making them a non-negligible part of the NEA. DART and Hera are two missions planned to the Didymos 65803 binary asteroid system. They will be launched in 2021 and 2023, respectively.

Hera, the European part of the mission to Didymos 65803, includes CubeSats that will orbit the smaller body of the binary asteroid system in a Distant Retrograde Orbit (DRO). As the distance between the centers of mass of the primary bodies of the system is around 1.18 km, the CubeSats will fly close to them. In this case variations in modeling of the binary system, such as the detailed shape of the primary bodies, the order of the gravitational potential model, or the distance between them, has an impact on the Restricted Full Three Body Problem (RFTBP), which is reflected on the trajectories for the CubeSats. Even well-known systems, such as the targeted Didymos binary asteroid system, have uncertainties in their models.

Most of the previous generic studies describing the dynamics of a binary system have used sphere-ellipsoid or oblate sphere-ellipsoid models with second order of the gravitational potential. In this study, the Full Two Body Problem (FTBP) is studied using a higher order gravitational potential model and considering an arbitrary shape of the primary bodies. The solar radiation pressure is also included in the model used to design trajectories of spacecrafts based on the FRTBP. This study is contributing to the field of spacecraft dynamics by examining the effect of:

- the shape of the primary bodies on the FTBP and the FRTBP using a higher order gravitational model;
- the variations of different parameters of the model of the binary asteroid system on the dynamics of a spacecraft orbiting in its vicinity.

The contributions made by this study are both fundamental and practical. They will enhance the fundamental knowledge of the dynamics of a spacecraft in a binary asteroid environment. The spacecraft trajectory designers will then be able to apply them to know how the variations of the binary system model affect the trajectories of a spacecraft in such an environment.