EFFECTS OF THE ERRORS IN THE PHYSICAL PARAMETERS TO OBSERVE THE TRIPLE ASTEROID $2001SN_{263}$

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Asteroids are very interesting bodies to be studied. They help to make scientific discoveries related to the history of the solar system. They can also be used to extract materials that are scarce on Earth. Another important point is to study how to deflect an asteroid that is in route of collision with the Earth. For all possible types of mission, it is important to send spacecraft to them, to see their composition, masses, orbits, etc. So, it is necessary to find orbits that are adequate to place those spacecraft, which is not easy since the physical parameters of most of them are not accurately known. The present research has the goal of studying the effects of errors in the determination of the physical parameters of the asteroids in the trajectories of a spacecraft travelling around them. The triple asteroid system $2001SN_{263}$, a Near Earth Asteroid (NEA), is used as an example. There are two smaller bodies (called Beta and Gamma), with diameters of 0.78 and 0.58 km, respectively, orbiting the central body that has a diameter of 2.6 km. Useful trajectories are found, which are the ones that can observe the three bodies even in the presence of errors in the physical parameters. To select the trajectories, the time histories of the distances between the spacecraft and the three bodies of the system are used. In this way, this research has a first objective of searching for trajectories to keep the spacecraft as long as possible near the three bodies without requiring orbital maneuvers. It is assumed that the mass of the central body is known, leaving the analysis of the errors for the masses of the smaller and less known bodies. The orbits are obtained by numerical integrations of the equations of motion. The model assumed for the numerical simulations takes into account all the information known about this triple asteroid system, such as their sizes, masses and shapes. The solar radiation pressure is included in the model, since it is a very important component of the dynamics around asteroids, because they have weak gravity fields. It assumes elliptical orbits for the smaller bodies around the central one, but those orbits are precessing due to the non-spherical format of the central body. The oblateness of the central body also affects the trajectory of the spacecraft. The reference system uses the Beta orbital plane as the reference plane. It is also verified the occurrence of collisions of the spacecraft with one of the bodies of the system and the possibility of escapes from the system. Special attention is given to trajectories around the central body that can observe two or even the three bodies of the system.

Topic: Advancements in Near Earth Object (NEO) Discovery

Prospects for future NEO survey systems and efforts.