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Orbit Determination of LICIACube: Expected Performance and Attainable Accuracy

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LICIACube (Light Italian Cubesat for Imaging of Asteroid) is a 6U cubesat project led by the Italian Space Agency (ASI), to be carried by NASA's DART (Double Asteroid Redirection Test) mission to the Didymos binary asteroid system. The DART mission objectives are to measure the change in momentum of Didymos secondary (informally called Didymoon) after the impact, characterize the asteroid composition, and increase the knowledge of the system physical parameters in order to assess the performance of the asteroid deflection strategy.
The main goal of LICIACube is to support DART mission goals by taking images of the impact effects on the surface and the generated ejecta plume.
LICIACube will be deployed from DART in proximity of the target, before the impact, and will perform an autonomous fly-by of Didymos.
Ranging and Doppler measurements between the smallsat and the ground antennas of NASA's Deep Space Network (DSN) will be acquired before and after the impact. Radiometric measurements, together with optical pictures of the Didymos system, will be jointly processed to perform the orbit determination of the cubesat. Moreover, gravity investigations performed using radiometric and optical data could be useful also to constraint the physical parameters of the Didymos system.
In this work we present a covariance analysis of the orbit determination of LICIACube, obtained through numerical simulations. During this phase of the project, the knowledge of the expected accuracy of the smallsat orbit is of foremost importance for both mission and trajectory analyses, in order to optimize the observation conditions and maximize the scientific return of the mission.