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THE COMET ASTROBIOLOGY EXPLORATION SAMPLE RETURN (CAESAR) FLIGHT DYNAMICS

Abstract

Comet Astrobiology Exploration Sample Return (CAESAR) is a proposed mission to return a sample from comet 67P/Churyumov–Gerasimenko. CAESAR is one of two finalists in NASA's New Frontiers Four selection process. The mission's objective is to improve our knowledge of solar system formation and on the building blocks of life by examining the comet's volatiles, composition and dynamics properties. In this paper, the mission flight dynamics will be discussed. Several factors make the trajectory design for this mission challenging, such as rendezvous with a highly-inclined highly-eccentric target, delivery of the sample return capsule back to Earth, and coping with communication, thermal, and other operational requirements at the farthest distances from Earth. A successful design that meets the mission and operational constraints was made possible using an electric propulsion system that provides maneuverability to the spacecraft and robustness to the trajectory. In this paper, key aspects of the mission's design will be outlined together with special emphasis on the design process. A set of flight dynamics tools were developed for this study. These tools are built using the latest techniques in optimal trajectory design that enable a semi-autonomous design process requiring little user interaction during the baseline calculation and sensitivity analysis.