SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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DESIGN OF A MULTI-RENDEZVOUS MISSION TO JUPITER'S TROJANS

Abstract

At the L4 and L5 Lagrange-Points of the Jupiter-Sun-System populations of small bodies exist in stable orbits around the Sun, which are called Trojans. There are several hypotheses about the origin and formation of these populations, but it is widely agreed that data about the Trojans (e.g. composition, rotation periods, and topography) would shed light on the solar system's history as a whole. Consequently the interest in scientific space missions towards this target is high. In this paper the design for a spacecraft suitable for an ESA M-class Mission Call is described, as elaborated during DLR's 20th Concurrent Engineering Study in the Concurrent Engineering Facility in Bremen, Germany. As part of the paper the design process is shortly explained and the constraints of the design, i.e. mission and system requirements as applied during the study. Furthermore the final result and the trade-offs that led to it are elaborated in this paper. It is shown that a spacecraft with a launch mass of ca. 1600 kg can conduct a Trojan mission, carrying 6 scientific experiments (ca. 50 kg payload mass), which are based on already existing instruments from other missions (e.g. GRAND from Dawn or LORRI from New Horizon). Furthermore the various spacecraft subsystems, e.g. Data Handling, Attitude and Orbital Control, Power Generation or Communication, are described on an equipment level in this paper and we present the overall spacecraft configuration that is primarily driven by the need for large solar arrays. We summarize the mission trajectory that has been optimized using the software code InTrance and show that this mission can be conducted with solar electric propulsion, reaching the first target after ca. 5 years. Overall the current trajectories and spacecraft design allow rendezvous with four subsequent Trojan targets. We conclude with a statement about the feasibility of a multi-rendezvous mission to Jupiter's Trojans, which is referred to as Trojan Investigation Probe (TRIP).