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Author: Mr. Mohammed Ibrahiam
United Arab Emirates

ADVANCING SMALL SPACECRAFT CAPABILITIES FOR DEEP-SPACE MISSIONS: A COMPREHENSIVE OVERVIEW OF THE EMIRATES' MISSION TO THE ASTEROID BELT LANDER

Abstract

The Emirates Mission to the Asteroid Belt (EMA) represents a pioneering step forward in space exploration, undertaken by the United Arab Emirates. Aimed at exploring the uncharted territories of the asteroid belt situated between Mars and Jupiter, this mission signifies the nation's ambitious venture into deep-space. This bold endeavor highlights the UAE's growing capabilities in space technology and contributes significantly to the global understanding of space phenomena.

This paper explores the intricacies and complexities involved in crafting and advancing the design of the lander, an integral component of EMA. Engineered to venture into deep-space, the mission is dedicated to pushing the limits of small spacecraft capabilities. It incorporates employing innovative technologies and sophisticated subsystems, showcasing the evolution of compact explorers.

The core mission objective of the lander is to engage in comprehensive exploration of celestial bodies situated beyond Earth's orbit, with a specific focus on the asteroid Justitia. The mission aims to execute a controlled descent onto Justitia's surface all the while capturing crucial images of the asteroid during its decent to provide detailed insights into the geological and compositional features of Justitia. In addition to its primary imaging mission, the lander will encompass a suite of scientific payloads, designed to contribute invaluable data, offering insights into the asteroid's characteristics.

Throughout a 7-year cruise phase aboard the main spacecraft, the lander is tasked not only with survival but also with periodic health assessments to ensure continuous functionality. The core strategy involves striking a balance between the integration of Commercial Off-The-Shelf components for enhanced cost-effectiveness and the procurement of specialized components tailored for deep-space missions. This approach increases the lander's robustness and endurance, securing optimal performance over the prolonged duration of the mission.

This paper further details the crucial subsystems of the lander, essential for its functionality and mission success. It covers the Mechanical subsystem, ensuring the lander's durability for deep-space conditions and landing; the Command and Data Handling subystem for command processing and data management; the Electrical Power Subystem for power supply management; the Communication subsystem for data transmission to the spacecraft; and the Attitude Determination and Control Subystem for maintaining orientation during descent. These subsystems are analyzed for their roles in ensuring the lander's performance and achieving mission objectives, highlighting their intricate interplay and significance. Through its innovative design and successful deployment, this mission exemplifies the agility and potential of small spacecrafts to make significant contribution towards space exploration.