Paper ID: 85833
oral

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 2) (4B)

Author: Mr. Mohammed Alameri
UAE Space Agency, United Arab Emirates

Mr. Ben Reese
Laboratory for Atmospheric and Space Physics (LASP) at University of Colorado, United States
Mr. Michael Bonnici
Laboratory for Atmospheric and Space Physics (LASP) at University of Colorado, United States
Ms. Razan Alkaabi
UAE Space Agency, United Arab Emirates

EMIRATES MISSION TO ASTEROID BELT SPACECRAFT ARCHITECTURE

Abstract

With the growing interest in asteroid exploration activities, ground-based observation, close-proximity remote sensing of asteroids, as well as in-situ space resource utilization, the UAE announced its first mission to the main asteroid belt in October 2021, the Emirates Mission to the Asteroid Belt (EMA). EMA is planned to launch in 2028 and is set to perform 6 asteroid flybys and 3 gravity assists before reaching the 7th asteroid called Justitia, which is considered to be a high-science-rich asteroid by the science community. The Mohammed Bin Rashid Explorer (MBR Explorer) will travel 5 million km while accumulating a total of 11 km/s change in velocity through the use of a solar electric propulsion system while being exposed to a very dynamic thermal environment between 0.7 AU and 3.1 AU, driving the thermal design. The highest asteroid flyby speed is around 9 km/s relative velocity, which provides a short science acquisition window to capture asteroid images, requiring autonomous solutions without ground intervention to make it possible. The above drives the architecture of the MBR Explorer to operate for 8 years, with the majority of its lifetime on trajectory and a 7-month science period acquisition. Thermal design is driven by the closest distance to the Sun after the Venus gravity assist to operate the solar electric propulsion thrusters and at 3.1 AU when the spacecraft has the lowest internal heat dissipation in safe mode. The mission needs to accumulate a total of approximately 11 km/s through the use of the SEP thrusters to have propellant throughput for more than a ton of xenon gas. Maximizing time utilized in thrusting with adequate pointing accuracy is required to allow minimizing utility operations which size the momentum capacity and show the need to equip the thrusters with structural mechanisms for controlled pointing. At the period of closest approach to the asteroids, the spacecraft and asteroid relative velocity is high, demanding the system to have agility and slew rate requirements to be able to point and track the asteroid during this short period, which also demands the guidance navigation and control to be equipped with an autonomous optical navigation system that can update pointing profile while approaching the asteroids' flybys. In this paper, MBR Explorer's driving capabilities are reflected in the architecture, and a glance at the spacecraft design is summarized.