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DESIGN OF A CUSTOM OPTICAL PAYLOAD TO MONITOR OCEAN COLOR BY AN EDUCATIONAL 3U CUBESAT

Abstract

The present paper presents NEMO (Nanosatellite for Earth Mapping of Ocean phytoplankton), the educational space mission designed by the students of the CubeSat Team Polito, based in Politecnico di Torino. NEMO is an Earth Observation mission carried out by a 3U CubeSat. While a CubeSat can only host a payload with limited performances, the value of the data such a platform can produce relies upon the higher revisit time (compared to bigger satellites in higher orbits) and the optimization of the observed frequencies, if the payload is tailored to the specific application. That is the spirit of the NEMO mission: performing optimized ocean observations to evaluate the water color and its evolution. This information holds inestimable value for the scientific community to assess the impact of climate change on oceans worldwide. Remote sensing has a privileged view of the oceans, as it provides a global view of large areas. By monitoring ocean colour, which is defined as the interaction of incident visible light with seawater, it is possible to assess its impact on the overall ocean health. NEMO observation focuses on phytoplankton, which is an indicator of chlorophyll-a concentration. To conduct such precise observation, the optimal approach is to develop a customized payload with the required characteristics. These requirements are obtained through research with the support of different scientific institutions and then used as a base for the development of the optical payload. This paper provides an overview of the scientific background, describes the NEMO mission design, and outlines the methodology and outcomes of the payload initial sizing phase, wherein radiometric power estimation is conducted to assess signal-to-noise ratio. Then, taking into account volume and budgetary limitations, an optical system design is presented and its performance evaluated. The paper discusses any alterations made and potential avenues for future advancement. Finally, the paper covers some considerations about the challenges of developing a custom optical payload in a student team.