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THE DESIGN OF A 3U CUBESAT TO MONITOR THE GREAT PACIFIC GARBAGE PATCH FOLLOWING A SYSTEMS ENGINEERING APPROACH

Abstract

This paper proposes a novel application of a CubeSat to help tackle one of the most alarming calamities in the present time, the Great Pacific Garbage Patch (GPGP). One of six similar accumulations of garbage across the world's oceans, the GPGP is without a doubt the largest. Covering an area three times the size of France at 1.6 million square kilometres and weighing in at over an estimated 80,000 metric tons, the ocean is drowning in plastic. Traditional Red-Green-Blue (RGB) satellite observation methods have proven ineffective in observing the waste floating in the GPGP. Current research efforts to monitor the GPGP's growth have involved various aircraft flyovers paired with numerous trawler missions. A more effective method of monitoring the GPGP's growth and movement has been identified through use of a CubeSat mission, named the UWECUBE-1, utilizing near-infrared spectroscopy (NIRS), which could significantly improve the efficiency of trawler ocean clean-up missions. The NIR spectrometer will capture wavelengths reflected by polypropylene (PP) and polyethylene (PE) plastics which make up the majority of the floating debris in the GPGP.

The project presents a preliminary Systems Engineering solution, a space mission devoted to tracking the growth and movement of the GPGP. Various systems engineering tools and techniques have been used to reach a suitable design through an iterative process. A 3U CubeSat form has been chosen for the mission to accommodate multiple forms of system redundancy within the data handling and attitude control subsystems. The CubeSat will be placed into a low-earth sun-synchronous orbit with an inclination of 97.7 degrees to provide a consistent high level of light exposure during observation. The mission will involve a capture and downlink process whereby the data collected during the observation phase will be stored and then downlinked during multiple passes over the ground station. The mission will initially be used solely for monitoring the GPGP for research purposes, however following proof of concept the same design has the potential to observe all six garbage patches therefore providing huge benefits to the conservation of marine wildlife and the environment.