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CONCEPTUAL DESIGN AND FLIGHT SIMULATION OF SMALL SATELLITE PAYLOAD RECOVERY SYSTEM USING AN AUTONOMOUS GUIDED PARAFOIL BASED ON COTS

Abstract

Small satellite fast-growing market size can be discussed from two different angles. At first sight, it helps humans to develop technology and get access to more data from a top view above the planet, but in fact, it adds millions of manipulated objects to orbit. Small satellite guided payload recovery is one of the methods that can help us test new technologies in orbit and bring them back to Earth on a predefined specific target. This may have hundreds of challenges in the way, but it is worth investing time and energy in it to get closer to space sustainability by stopping producing extra amounts of space debris. Some of the challenges that are still being studied are deorbiting and reentry process, wind speed at high altitudes, and air uncertainties that cause errors during the descent of a fully autonomous guided payload recovery system.

This paper presents the conceptual design, trajectory planning, and 6 degrees of freedom simulation of control modes for a 2 kg autonomous guided Parafoil system using Commercial off-the-shelf (COTS) components. Different simulations were used to perform structural design and component placement, the airflow on the Parafoil, and also dynamics and control of the system, assuming Parafoil deployment from 30 km above the ground. Monte Carlo simulation is used to model different outcomes of environmental situations, which shows the high reliability of this system. The designed Parafoil targets an area of 500 meters diameter on the ground and is equipped with a set of sensors, along with servo motors as actuators to meet mission requirements in each descent level.

This autonomous guided payload recovery system will be the game changer in the Nano satellite market by defining a new sustainable and cost-effective way of lightweight payload technology demonstration.