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SWARM ROBOTICS BASED CUBESATS FOR REMOVING LARGE SPACE JUNK IN LOW EARTH
ORBIT

Abstract

Space junk debris and near earth objects have always been a problem for space operation missions, and since they are increasing dramatically throughout the years, space agencies are constantly implementing mitigation measures. According to the report of the European Space Agency's (ESA) Space Debris Office of January 2019, the number of objects estimated by statical models to be on orbit that is superior to 10 cm (i.e. large debris) are over 34000 objects. Since we are in the midst of space conquest, the amount of garbage circling the Earth will continue to increase. By corollary, this paper aims to bring a new, economical and efficient solution to remove space junk. This concept is titled KamikazSats. The mission targets large sized space junks in LEO orbit such as rockets, payload fairings, launchers, and dysfunctional satellites.

Furthermore, the main objective is to launch a block of low-cost CubeSats using swarm robotics technology for space debris capturing and removal. The paper discusses the functionality and feasibility of the proposal. In addition to that, it explains how this concept can be effective comparing to other past proposals and describes how the prototypes will be developed.

During the mission, this block will separate to form a constellation of CubeSats once in the LEO orbit. The purpose of using multiple CubeSats is a sort of redundancy aiming to reduce the risk of failure of the mission. Besides, the trajectory of the KamikazSats will be already predetermined in order to intercept a targeted space junk. Indeed, this trajectory will be analyzed and integrated into the control system according to the position of the targeted object based on data provided by remote sensing ground stations.

Each CubeSat will eventually be equipped with a robotic arm that will seize the targeted space junk. These CubeSats will also be equipped with an independent propulsion system that will carry the debris at lower altitudes in order to undergo an atmospheric entry that will lead to the total disintegration of the debris and CubeSats.

Currently the work is in a prototype stage; it can be further customized based on a mission-specific requirements.