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UNVEILING ROGUE EXOPLANETS: SWARM CUBESAT TELESCOPE

Abstract

This study aims to answer a fundamental question humans have long asked: Are we alone? The goal is to couple swarm technology with CubeSats as telescopes for exploring exoplanets by capturing the difference in brightness, called gravitational microlensing. Recent data shows that 29 active space telescopes exist, of which only three are capable of discovering distant and rogue exoplanets since most telescopes require additional resources for this purpose. We propose a system of 12U Cubesats, each satellite called a node, equipped with a reflexive telescope of Cassegrain design and CMOS detectors to observe at multiple wavelengths, enforcing gravity microlensing. Distributive Model Predictive Control and Behaviour Control enable precise coordination between each node in the constellation, collectively acting as a single telescope with a significant effective aperture. These allow for simultaneous detection of the subtle dimming of starlight in (rogue) exoplanets microlensing a distant star. Each node captures data as light curves and is processed and analyzed through algorithms such as Centroid Motion Algorithm and Peak Detection Algorithm. Next, this data is run through thresholding techniques such as Simple Statistical Thresholding to distinguish potential events from noise fluctuations. The processed data is communicated to the ground through a series of nodes, where the receiving node verifies any information lost. Each satellite finds and selects the path having the shortest distance and cost, achieved through heuristics. We expect a swarm telescope's superior sensitivity system to facilitate the detection of smaller and more distant exoplanets, both rogue and in an orbiting system. Their continuous monitoring and wide view field significantly increase the probability of microlensing event detection by about 80% and increased sky coverage by about 50%. The mechanism of nodal data transmission should optimally reduce loss of information by about 7% as compared to traditional methods of communication. This data obtained can be used to reconstruct properties of the exoplanet, such as mass and orbital trajectory. Aligned with the United Nations' sustainable development goals 16 and 17, a swarm telescope system could foster potential collaboration among countries and promote peace and sustainability. By potentially revealing a new class of exoplanets, this swarm CubeSat telescope has the potential to revolutionize our understanding of planetary system formation and the possibility of life beyond our solar system.

Keywords: Exoplanet, telescope, node, sustainability, microlensing.