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# MAXIMIZING LIMITED VOLUME: A GENETIC ALGORITHM-BASED APPROACH TO CUBESAT SOLAR PANEL AND ANTENNA DEPLOYMENT PATTERN DESIGN

**Abstract**

CubeSats are becoming increasingly popular as a cost-effective and efficient means of conducting space missions. However, their small size presents several challenges to their design and capabilities, particularly with regard to volume efficiency. The limited volume of CubeSats requires careful optimization of the use of available space for components such as solar panels and antennas. In this paper, we propose a genetic algorithm-based approach to design the deployment pattern for CubeSat solar panels or antennas that maximizes volume efficiency. The approach involves defining a fitness function that evaluates the design based on several criteria, including the surface area of the deployed solar panel or antenna, the stability and reliability of the deployment mechanism, and the volume occupied by the deployed structure. We apply the proposed approach to a case study of a CubeSat antenna deployment pattern design and demonstrate its effectiveness in optimizing volume efficiency. The results show that the proposed approach can achieve a significant improvement in volume efficiency while meeting the design criteria. Specifically, we find that the approach can generate deployment patterns that occupy less volume while still providing the necessary surface area. Furthermore, we compare the results of our genetic algorithm-based approach to traditional deployment patterns. The comparison shows that the genetic algorithm-based approach outperforms the traditional method in terms of both volume efficiency and computational efficiency. This approach provides a useful tool for engineers and designers to optimize the deployment pattern of CubeSat components while considering volume constraints, ultimately improving the capabilities of small satellites. Overall, this paper highlights the importance of volume efficiency in CubeSat design and proposes a novel approach to optimize it using a genetic algorithm-based design methodology. The results demonstrate the potential of this approach to improve the efficiency and performance of CubeSats in space missions.