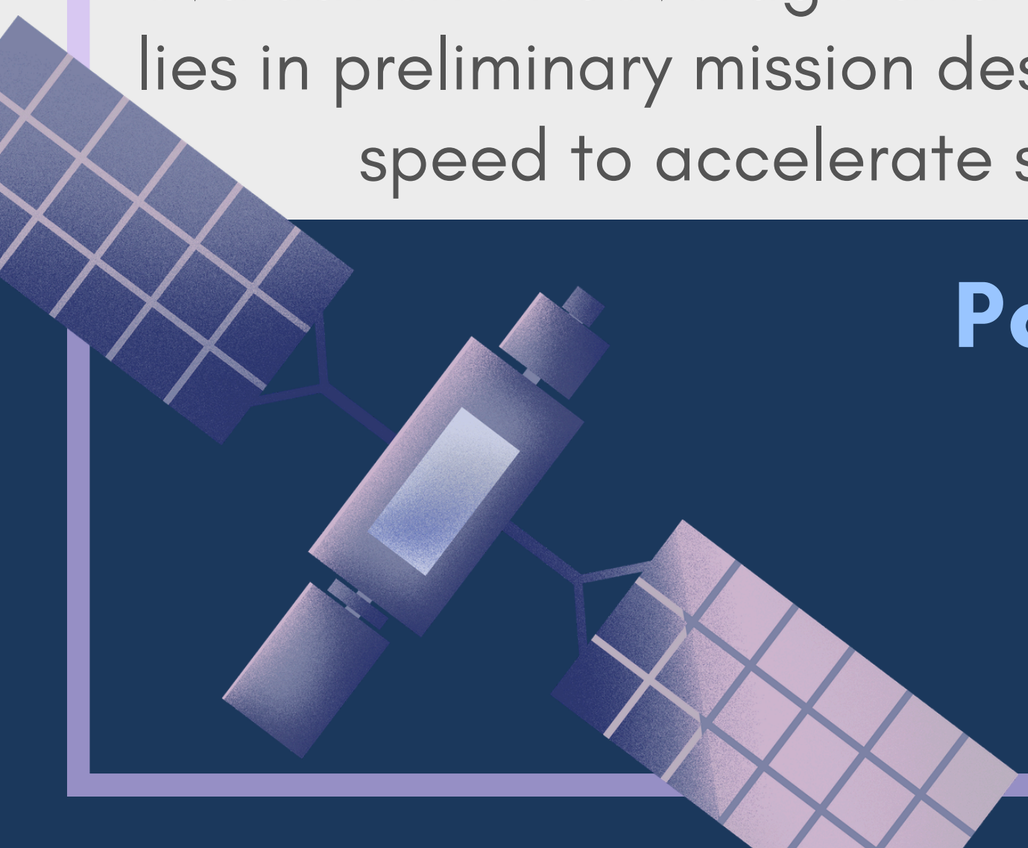
Optimization of Repeat Ground Track Constellation Design for Complex Regional Coverage

The continued growth of LEO satellite constellations motivates efficient constellation design methods to reduce cost and complexity. Although brute-force methods are commonly employed in the preliminary design of satellite constellations, pairing analytic methods with optimization algorithms provides a more efficient means of searching the design space. Constellation design for continuous global and regional coverage is well-established; however, strategies for discontinuous regional coverage remain underdeveloped. This thesis focuses on implementing an analytic geometry-based method for computing satellite coverage and revisit metrics, coupled with genetic algorithm optimization to efficiently explore the design space. The viability of this method is shown through four unique case studies, applied to varying regional coverage problems. Additionally, a novel geometry-based approach computes a lower bound on the achievable and guaranteed coverage area for a repeat ground track satellite constellation. These approaches eliminate the computational overhead inherent to numerical propagation and the discrete-time-step evaluation of coverage and revisit metrics. The key application of this work lies in preliminary mission design, where the improvement of computational speed to accelerate search space exploration is paramount.



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May 28, 1:00 pm

Building 41-217