SYSTEM DESIGN FOR A VLEO SMALL SATELLITE MISSION

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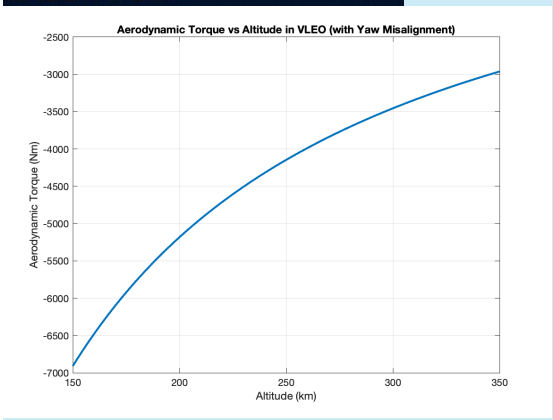
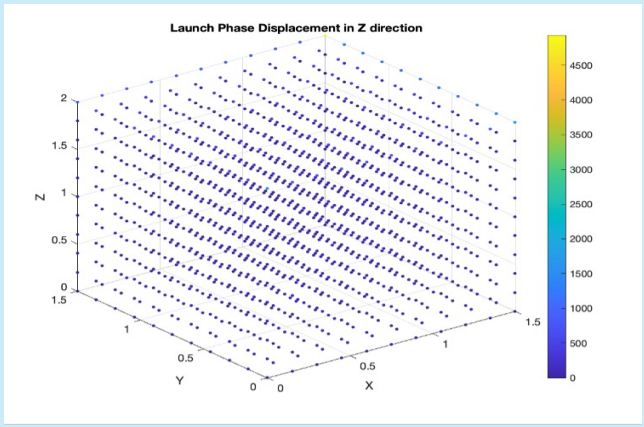
Abstract

This thesis focuses on designing a satellite system for Very Low Earth Orbit (VLEO) missions operating below 450 km. VLEO presents unique challenges, such as increased atmospheric drag and shorter orbital lifetimes, but also offers opportunities like enhanced imaging resolution and reduced communication latency. The thesis systematically analyses critical propulsion, communication, power, and payload subsystems using advanced simulations to assess performance and feasibility in the VLEO environment. The research highlights key findings and design innovations that address VLEO challenges, contributing to advancements in satellite technology for applications like Earth observation and telecommunications.





Altitude (km)	Aerodynamic Torque (Nm)
400	3.41x10-6
300	2.42-10-5
200	3.09x10-4
150	2.17x10-3

Table 4: Aerodynamic Torque vs Altitude

Conclusion

This thesis presents a comprehensive satellite design for Very Low Earth Orbit (VLEO), focusing on the structural integrity and propulsion system needed to operate in this challenging environment. The mechanical design ensures that the satellite can withstand the stresses of launch and the dynamic forces experienced in VLEO. A hybrid propulsion system—combining electrical propulsion for continuous operations and chemical propulsion for high-thrust maneuvers—effectively mitigates atmospheric drag.

The research highlights the potential for longer-duration missions, benefiting from improved resolution and reduced communication delays. However, challenges such as fuel efficiency, power management, and attitude control remain critical for further advancement. Addressing these issues will be essential as VLEO satellite technology evolves, with promising applications in Earth observation, communications, and scientific missions.