# Summary

Space is increasingly becoming a frontier for both scientific discovery and commercial development. However, economic and technological barriers have long hindered its large-scale expansion. Missions such as Active Debris Removal, In-Space Servicing and Manufacturing, and the design of space transportation architectures for exploration campaigns require new methods grounded in a logistics-driven perspective, commonly referred to as *Space Logistics*.

Due to the inherent complexity of these problems, no general solutions currently exist. The trade-off between applicability, accuracy, and computational cost remains the key factor distinguishing existing approaches in the literature.

The goal of this dissertation is to advance the field of space logistics by developing novel methodologies to address mission design challenges in both planetary and cislunar contexts. A unified solution framework is developed for those cases where space trajectory optimization plays a central role. The framework is then employed to develop methodologies for specific problem instances, where the defining characteristics of each case—such as orbital regimes, perturbations, and mission constraints—guide the methodological approach. This leads to a clear distinction between planetary space logistics—defined as logistics problems where all mission actors operate in the vicinity of a primary body, in this case the Earth—and cislunar space logistics.

In the planetary context, solutions are initially developed for the time-independent case, where orbital perturbations are neglected. The main contribution is a methodology that achieves very low computational cost for solving the space counterpart of the *Traveling Salesman Problem* in low-thrust servicing missions on elliptical orbits. This approach is extended to more complex scenarios involving multiple servicing spacecraft and additional mission constraints, such as limited time and propellant. In this context, a new modeling approach is developed to address the space counterpart of the classical *Knapsack Problem*, providing scalable solutions with low computational cost while ensuring global optimality and maintaining accuracy.

The planetary time-dependent case is then addressed by introducing the *Time Varying Interpolation Method*, specifically designed to capture perturbative effects that cannot be neglected. This method demonstrates high flexibility across different orbital regimes, allowing nonlinearities to be easily incorporated into the optimization process. Its applications show accurate results, low computational cost, and strong adaptability across diverse planetary logistics scenarios.

In the cislunar context, the unified solution framework leads to the derivation of the *Request-centric modeling*, a novel methodology for the optimal design of space transportation architectures in the cislunar environment. This approach achieves low computational burden, high flexibility for the straightforward inclusion of nonlinearities, and supports the exploration of multi-objective trade-offs, as demonstrated in scenarios involving the servicing of satellite constellations distributed across the cislunar space.

Ultimately, this research provides new solutions to space logistics challenges, contributing to the long-term vision of affordable, sustainable, and commercially viable space missions.