Technische Universität Braunschweig

Student thesis announcement (SA/MA)

Optimization of a Depot-Based In-Space Transportation Ecosystem

Propellant depots are posited to play a significant role in the future space economy, enabling increased reusability, reduced launch costs, and extended satellite operational lifetimes through in-orbit servicing (IOS). This architecture represents a departure from traditional point-to-point mission profiles. Instead, satellites may be launched into a designated parking orbit and subsequently transferred to their final mission orbit by dedicated orbital transport vehicles (OTVs) that operate by refueling at strategically placed orbital propellant depots.

Optimal placement and sizing of the depots, associated tankers, and transport vehicle fleets necessitates a rigorous analysis of current and projected orbital transportation demands. This must be coupled with a logistics-driven modeling and optimization technique. The objective of this thesis is to develop a scalable space logistics optimization tool and apply it towards realistic application scenarios derived from a comprehensive market analysis of the global space launch industry.

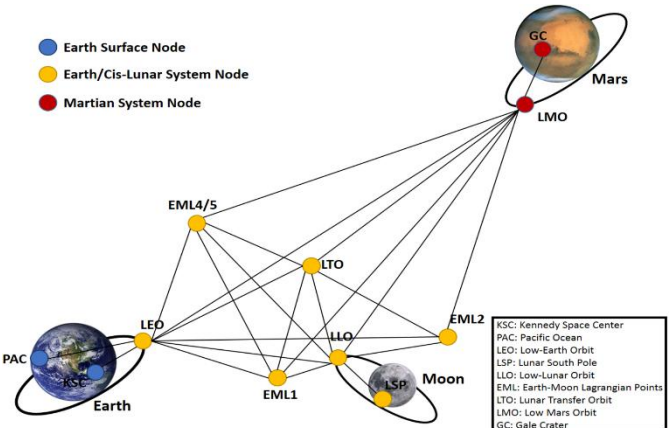

Figure 1: Network model for Earth-Moon-Mars exploration logistics [1]

Tasks:

- Literature research on the current and future demand for space transportation services, usage of cryogenic propellants for in-space transportation, potential propellant depot architectures, and space logistics optimization methods.
- Development of a space logistics model and appropriate optimization strategy
- Optimization of a logistics network for different scenarios based on an analysis of the space launch market.

Requirements:

- Capable of working in a reliable and self-motivated way
- Basic knowledge in Python

[1] Chen, H., Lee, H. W., and Ho, K., “Space transportation system and mission planning for regular interplanetary missions,” Journal of Spacecraft and Rockets, Vol. 56, 2019, pp. 12–20. https://doi.org/10.2514/1.A34168.

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