Chair of Space Mobility and Propulsion
Department of Aerospace and Geodesy
TUM School of Engineering and Design
Technische Universität München

Bachelor's Thesis

Task description for Bachelor's Thesis of

Name Surname

System Identification for Minimization of Model Mismatch in Optimal Control

System Identifikation für die Minimierung von Modelabweichungen für Optimale Regelung

Topic

The space sector is currently gaining more and more interest due to the commercialization of Space (OneWeb, SpaceX Starlink) and upcoming human missions, such as the return to the lunar surface and the goal to land humans on Mars. The remoteness of these missions and their high complexity demand high autonomy in the spacecraft's control systems.

Spacecrafts, especially the propulsion systems, are complex machines made up of several subsystems. Accurate control is essential for mission success, particularly for landing manoeuvres. The current traditional industry standard uses a hierarchy of conventional control algorithms, mainly due to their predictable behaviour and the ability to prove stability. For landing manoeuvres, optimal control algorithms have shown promising results by making use of knowledge of system dynamics and by being able to enforce boundary conditions. One challenge of optimal control is the reliance on an accurate model of the system dynamics, which can be complex to derive or unknown.
This ties into the ASCENT project at the chair of space mobility and propulsion, where a vertical take-off vertical landing rocket hopper is in development as a research platform for advanced control algorithms, including optimal control.

The goal of this thesis is to increase the robustness of optimal control algorithms by reducing model-reality mismatch. This shall be done by implementing a basic system model of a subscale hopper for data generation, and then comparing, implementing, and testing system identification methods to bridge model mismatch for the use with optimal control algorithms.

Tasks

1. Subdivision into work packages with sub-tasks and creation of a time plan
2. Literature research on (online) system identification methods
3. Implementation of a hopper system model
4. Implementation of system identification methods
5. Analysis and comparison of the implemented system identification methods
6. Documentation and presentation of results

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