Chair of Space Propulsion and Mobility
Department of Aerospace and Geodesy
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Bachelor / Semester / Master's Thesis

Development of a Reconfigurable Rocket Engine Control System Framework including Frequency Response Feedback

Background

Traditionally, liquid rocket engines control systems are based on a closed control loop with feedback of different physical signals to maintain a certain load point by adapting the actuators, namely valves. In recent years, the demand for reusable and throttleable rocket engines has grown constantly. Associated with this are higher requirements in terms of component lifetime as well as an extended operational envelope of the engine, which brings along engine instabilities. Having a robust control system being able to control engines in a wide operational envelope and cope with ageing effects is crucial to allow new mission profiles.
The goal of the underlying research project is to develop a reconfigurable control system based on frequency response by means of model-based design (from Model in the Loop to Hardware in the Loop) to allow agile development. Eventually, this control system will be implemented on the **AIREP** (**AI**rborne **RE**search **P**latform; similar to the Figures below), a 6DOF free flying Hopper propelled by a hot gas engine.


SpaceX Grashopper

The scope of this thesis therefore comprises to establish a MIL framework for a reconfigurable control system. This control system framework will be able to exploit commonly used feedback signals (mass flow, pressure, and temperature) but also frequency response signals from various components. By using frequency response signals, the expectation is that the onset of instabilities can be predicted and counteracted actively.

The tasks break down into

- Literature research on control systems and frequency signal characteristics linked to rocket engines
- Development of a Model in the Loop framework
  - Decision on an implementation environment
  - Implementation of an engine model
  - Implementation of the control system, including the engine model
- Verification of the control system functionality
- Documentation and presentation of results

Contact

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