# DEEP

Advanced Diagnostics Environment for Electric Space Propulsion

| | | | |
|---|---|---|---|
| **Programm / Ausschreibung** | COIN, Aufbau, COIN Aufbau 8. Ausschreibung | **Status** | abgeschlossen |
| **Projektstart** | 01.01.2021 | **Projektende** | 30.06.2024 |
| **Zeitraum** | 2021 - 2024 | **Projektlaufzeit** | 42 Monate |
| **Keywords** | new space, CubeSats, thermal vacuum, lumped model, simulation, plume diagnostics, plasma, ion thrusters, spacecraft interaction, electric propulsion, chemical propulsion, Faraday cup, QCM | | |

## Projektbeschreibung

WIDER CONTEXT

The space industry is presently transforming rapidly. Whereas governmental agencies were the main drivers behind space programmes in the past, a paradigm shift has taken place over the last years due to much higher involvement of private companies largely independent of activities driven by space agencies. The companies involved in this so-called “new space” business have significantly different approach to a development. Quicker turnaround times and, in general, a broader system engineering approach area only two differences defining their strategy. This has also an impact on FOTEC and FHWN and requires to adapt and expand their set of tools and offered test services.

RELEVANCE TO CONSORTIUM

For FOTEC and the FHWN this has resulted in the opportunity to become much deeply involved in this industry by providing test services or by supporting developments of space hardware ranging from individual subsystems to complete CubeSats. An essential aspect here is the interaction of the subsystems with the satellite, e.g. heat fluxes from a thruster to other subsystems, as well as the interaction of the satellite with its environment, e.g. contamination of the satellite by the plume from the thruster.

CORE IDEA OF THE PROJECT

The proposed project aims at expanding on the expertise of the propulsion system and its interaction with the surrounding satellite. These interactions shall be studied numerically as well as experimentally.
Performing detailed numerical simulations of the thermal state of a whole satellite, even as small as a CubeSat, requires an enormous amount of CPU time which makes it unsuitable for practical implementation. A solution to this end is to use lumped models. Such models are less complex and therefore requires far less computational time. However, constructing such models should be done in such away that the overall thermal behaviour is representative. Within the project, competences will be built up to construct such lumped models. This is achieved by performing detailed numerical simulations, verify the results by means of experimental investigation (thermal vacuum tests) and refine the lumped models.

Contamination of the satellite by the plume of a chemical or electric thruster, is a serious problem that should be assessed prior to a mission. Such assessments are typically done by a mix of modelling and experimental investigation. Over the past couple of years, a number of new propulsion systems have entered the market for which detailed studies of the plume properties have not been carried out. The project aims at establishing effective means to investigate the plume numerically as well as experimentally (plasma diagnostics). Typical properties to investigate are the charge distribution within the plume with Faraday cups, the presence of any unintended molecules (e.g. droplets) with QCMs, as well as the stability of the thrust vector in level and direction supported by direct thrust measurements.

## Projektpartner

- FOTEC Forschungs- und Technologietransfer GmbH