Universität Stuttgart

Master Thesis Topic

On the Preliminary System Design of a VLEO Earth Observation Satellite employing Air-Breathing Electric Propulsion

Context

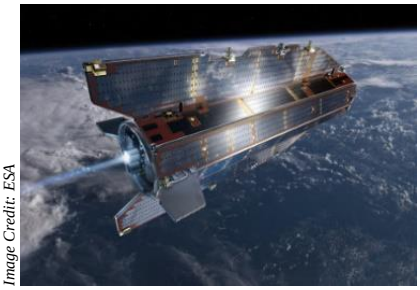

Image Credit: ESA

Very low Earth orbits (VLEO), i.e. such orbits below approximately 450 km altitude, provide significant benefits particularly for Earth observation spacecraft. Especially imaging resolution and quality can be greatly increased compared to higher-flying missions with similar payloads. Simultaneously, at a time in which large satellite constellations raise great concerns about space debris, VLEOs offer a naturally sustainable orbital environment in which spacecraft without active orbit maintenance will deorbit within a short time.
VLEO so far has not been a widely used orbital regime due to the difficulties and effort involved in the required constant orbit maintenance to achieve a reasonably mission lifetime. A solution to this challenge is offered by Air-Breathing Electric Propulsion (ABEP): ABEP systems make use of the still relatively dense atmosphere, collect the residual atmosphere in front of the satellite via an intake and use it as propellant for an electric thruster. Such an ABEP system is currently under development at the Institute of Space Systems of the University of Stuttgart (IRS).

In parallel, together with German industry and research institutes, the IRS is carrying out a Technology and Design study on the use of its ABEP system on VLEO satellites for the European Space Agency.

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Within the abovementioned context, a preliminary system design shall be carried out for an Earth observations satellite with an ABEP system, flying at an altitude between 180 and 250 km. The work shall include:

- Carry out a functional analysis of a VLEO satellite with an ABEP system and derive system drivers
- Identify and define system requirements
- Carry out trade-offs & optimization between different system concepts
- After the choice of a system concept: conduct preliminary design of the satellite, particularly including:
  - Design of communication system and approach, including selection of components
  - Design of electrical power system, including solar array configuration and selection of components
  - Estimate and draft of thermal control system (particularly radiators)
  - If relevant: sizing and layout of aerodynamic control surfaces
  - Draft of structural configuration and layout, including building of a first CAD model.

The work will be carried out in close collaboration with experts at the IRS and the collaborating industry/research institutes. Exact content is still subject to change.

Starting date: August/September 2021
Duration: 6 months

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