



Master Thesis Work

of Choose title Name, Surname

Erforschung der VLEO-Flugdynamik für den Satellitenbetrieb

Investigation into VLEO flight dynamics for satellite operations

Motivation:

The ATLAS research project at the University of Stuttgart aims to investigate the very low earth orbit (VLEO). The aim is to increase the lifetime of VLEO satellites by one order of magnitude. As part of this research project, the fundamentals of VLEO satellite operations are also being investigated. This is based on the expertise gained during the two still actively operated LEO satellite missions *Flying Laptop* and *EIVE* of the University of Stuttgart.

A so-called flight dynamics tool (FDT) is used to pre-plan satellite operations by propagating the satellite orbit based on GPS or TLE data. As part of an automated pipeline, this orbit propagation is used to calculate pass times over available ground stations as well as the trajectory of the orbit.

The aim of this master thesis is to identify the different requirements between a LEO and VLEO FDT based on the existing LEO FDT, as well as required features for an extended FDT. This should include an analysis of a suitable software architecture, but also of state-of-the-art algorithms and models for VLEO environment modelling. An analysis of the environment's sensitivity on the orbit propagation and measures to improve accuracy are to be investigated.

Task description of the Master thesis work:

- Familiarization with the existing LEO FDT
- Research on VLEO orbit influences and their effect on orbit propagation
- Research and comparison of FDTs used during previous VLEO missions
- Analysis on the differences between LEO and VLEO FDTs and necessary features for VLEO
- Analysis of algorithms and models needed to accurately depict VLEO conditions
- Analysis on the sensitivity of VLEO orbit propagation and measures to improve the accuracy
- Documentation

Supervisor: Markus Kranz, Julia Zink

Starting date: as soon as possible

Submission until: [Click for date](#)

Acknowledgement of receipt:

I hereby confirm that I read and understood the task of the master thesis, the juridical regulations as well as the study- and exam regulations.

Date

Prof. Dr.-Ing. Sabine Klinkner
(Responsible Professor)

Date

Signature of the student

Legal Restrictions: The Editor/s is/are principally not entitled to make any work and research results which he/she receives in process, accessible to third parties without the permission of the supervisor. Already achieved research results respect the Law on Copyright and related rights (Federal Law Gazette I / S. 1273, Copyright Protection Act of 09.09.1965). The Editor has the right to publish his/her findings unless no findings and benefits of the supervising institutions and companies have been incorporated. The rules issued by the branch of study for making the master thesis and the exam regulations must be considered.

IRS Professors and Associate Professors:

Prof. Dr.-Ing. Stefanos Fasoulas (Managing Director) · Prof. Dr.-Ing. Sabine Klinkner (Deputy Director) ·
Hon.-Prof. Dr.-Ing. Jens Eickhoff · Prof. Dr. rer. nat. Reinhold Ewald · apl. Prof. Dr.-Ing. Georg Herdrich · Prof. Dr. rer. nat. Alfred Krabbe ·
Hon.-Prof. Dr. Volker Liebig · Hon.-Prof. Dr. rer. nat. Christoph Nöldeke · Prof. Dr.-Ing. Stefan Schlechtriem · apl. Prof. Dr.-Ing. Ralf Srama

Declaration

I, **Name, First name** hereby certify that I have written this **please select a topic** independently with the support of the supervisor, and I did not use any resources apart from those specified. The thesis, or substantial components of it, has not been submitted as part of graded course work at this or any other educational institution.

I also declare that during the preparation of this thesis I have followed the appropriate regulations regarding copyright for the use of external content, according to the rules of good scientific and academic practice¹. I have included unambiguous references for any external content (such as images, drawings, text passages etc.), and in cases for which approval is required for the use of this material, I have obtained the approval of the owner for the use of this content in my thesis. I am aware that I am responsible in the case of conscious negligence of these responsibilities.

.....
Place, Date, Signature

I hereby agree that my **please select a topic** with the following title:

Enter title

is archived and publicly available in the library of the Institute of Space Systems of the University of Stuttgart **without blocking period** and that the thesis is available on the website of the institute as well as in the online catalogue of the library of the University of Stuttgart. The latter means that bibliographic data of the thesis (title, author, year of publication, etc.) is permanently and worldwide available.

After finishing the work, I will, for this purpose, deliver a further copy of the thesis along with the examination copy, as well as a digital version.

I transfer the proprietary of these additional copies to the University of Stuttgart. I concede that the thesis and the results generated within the scope of this work can be used free of cost and of temporal and geographical restrictions for the purpose of research and teaching to the institute of Space Systems. If there exist utilization right agreements related to the thesis from the institute or third parties, then these agreements also apply for the results developed in the scope of this thesis.

.....
Place, Date, Signature

¹ Stated in the DFG recommendations for „Assurance of Good Scientific Practice “or in the statute of the University of Stuttgart for „Ensuring the Integrity of Scientific Practice and the Handling of Misconduct in Science “