



Master Thesis Work

of Choose title Name, Surname

Vorauslegung eines hochgenauen Lageregelungssystems für einen Kleinstsatelliten zur Beobachtung des Nachleuchtens von Gammastrahlenblitzen

Preliminary design of a high-precision attitude control system for a micro satellite observing the afterglow of gamma-ray bursts

Motivation:

Gamma-ray bursts are cosmic events which are linked to the collapse of massive stars, but the mechanisms behind the phenomena are still under investigation. Events are first observed by space-based gamma-ray and X-ray telescopes, and a multitude of ground and space based telescopes are used to observe the afterglow. The intensity of the events fades by a factor of 15 within 10 minutes, hence a quick reaction is necessary for their observation. Ground based telescopes are restricted by earth's atmosphere and location, and current space based telescopes are large satellites. Advances in small satellite technology might allow for an affordable dedicated telescope which would increase the observation time and scientific data available. Astronomical observations require an extremely precise pointing, and larger spacecraft use highly sophisticated sensors and actuators for attitude determination and control. However, these sensors are not affordable for typical small-satellite missions. The goal of this study is to develop an Attitude Detection and Control System (ADCS) which fulfills the requirements imposed by the proposed gamma-ray burst telescope. These are:

- The slew rate needs to be 2-4 deg/s due to the quick fading of observation targets
- The settling time after slew needs to be less than 20 seconds
- The pointing repeatability has to be less than 30 arcsec (1σ)
- The pointing stability has to be less than 1 arcsec rms (1σ) over the measurement duration (>10min)

This thesis aims to prove the feasibility of this ADCS for a 10-30 kg small satellite, and to provide a preliminary design of the ADCS.

Task description of the Master thesis work:

- Literature research on ADCS for comparable (larger) missions
- Identification of key design drivers
- Trade-off for sensors and actuators
- Analysis of the capability of the preliminary design
- Documentation

Supervisor: Steffen Gaisser, Martin Fugmann

Starting date: as of now

Submission until:

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.

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

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 bachelor 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) ·

Prof. Dr. rer. nat. Alfred Krabbe · (Deputy Director) · Hon.-Prof. Dr.-Ing. Jens Eickhoff · Prof. Dr. rer. nat. Reinhold Ewald ·

PD Dr.-Ing. Georg Herdrich · Hon.-Prof. Dr. Volker Liebig · Prof. Dr.-Ing. Stefan Schlechtriem · PD Dr.-Ing. Ralf Srama