First Flight Results of the MOVE-II Satellite

Sebastian Rückerl, David Meßmann, Nicolas Appel, Jonis Kiesbye, Florian Schummer, Markus Fähling, Lucas Krempel, Tejas Kale, Alexander Lill, Gonzalo Reina, Patrick Schnierle, Sebastian Würl, Martin Langer

Institute of Astronautics

Martin Lülf

Institute of Communication and Navigation
MOVE-II

- Second Satellite at the LRT
- 1U CubeSat
- Built with >200 students
- Most components built in-house
- Primary objectives: education & satellite bus verification
- Scientific Payload:
  4 junction solar-cells
**MOVE-II**

- **Payload:** 4 junction solar cells
- **Dimensions:** 1U CubeSat
- **Communication:** UHF / VHF, S-Band
- **Computer:** OS Linux
- **Magnetic Attitude Control System**
- **Solar-Cells:** 12 W peak
- **Deployment mechanism:** Shape-Memory-Alloy based
MOVE-II

Custom SDR-Transceivers

Redundant Deployment

Integrated Magnetorquers
Launch

Dezember 3rd, 2018
18:32 UTC
Vandenberg AFB
First Signal on SatNOGS

Observation #349561

- **Satellite**: 43780 - MOVE-II
- **Station**: 23 – Zath-VHF
- **Modulation**: BPSK Telemetry
- **Frequency**: 145.950 MHz
- **Encoding**: BPSK12k5
- **Timeframe**: 2018-12-04 01:19:21 to 2018-12-04 01:31:03
- **Elevation**: 43.0°, 21.0°, 175.0°, 0.8
- **Metadata**: 4 items
- **Polar Plot**
- **Downloads**: Audio, Waterfall

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Sebastian Rückerl | Small Satellite Conference 2019
TLE Detection

Overpass on Sat 08.Dec.2018

Frequency offset [kHz]

UTC [HH:MM]
Fast Spinning MOVE

• Assumption that MOVE-II is spinning fast from observed signal
• Confirmed with first ADCS measurement on January 23rd
• Repeated measurements show increasing spin rate
• Assumed reason: current loop in solar-cell wiring
MOVE-II Payload

- 4 junction solar-cells
- Measurement of individual junctions
- First measurement while tumbling confirms turn-rate estimation
Attitude Controller Issues

- Stability problems due to high spin rates
- Caused by communication delays and measurement/actuation timings
- Stability boundaries investigated with simulations and hardware tests
Power Budget Issues

- Tight power budget (almost 1.9W orbit average)
- Verified with Hardware in the Loop simulation
- Reboots due to UVP
De-tumbling Timeline
Sun Pointing

• Regular actuations since detumbling
• Challenges due to tight power budget
MOVE-IIb

• Sister satellite of MOVE-II
• Changed solar-cell wiring with reduced loop size
• Additional ADCS controller suitable for fast spin rates (theoretical limit: 1200 °/s)
• Shortened commissioning procedure
MOVE-IIb: current state

• Launched into a SSO on July 5th
• Current TLE estimation: 2019-038N
• TX power of MOVE-IIb lower than expected (about 30dB reduced TX power compared to SONATE)
• Commissioning ongoing!
MOVE-BEYOND

We continue the development:

- Next generation satellite platform of the MOVE series
- Designed for flexibility
- Based on a distributed system of microcontrollers
- Will be used in several upcoming missions
Thank you for your attention!

Questions?

Sebastian Rückerl
s.rueckerl@tum.de

Acknowledgements