DISCO One – Reflective free-space optical communication demonstration for CubeSats

SSC20-WP1-32

Authors to whom correspondence should be addressed:
raphael.boeckle@spaceteam.at
sinn@acin.tuwien.ac.at

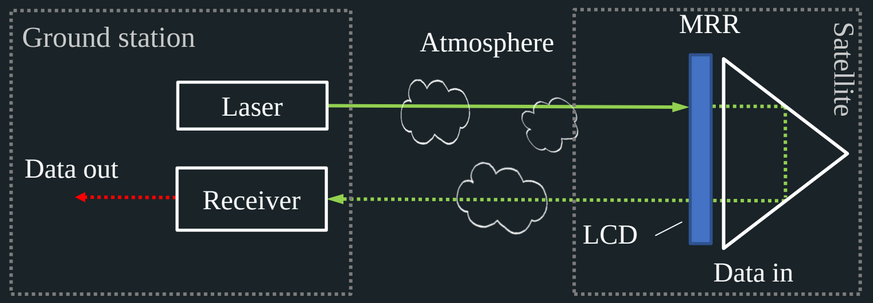
Raphael Böckle[1], Philip Olbrich[1], Andreas Sinn[1,2], Thomas Riel[1,2], and Georg Schitter[2]
[1] TU Wien Space Team, Floragasse 7, GA01C03, 1040 Vienna, Austria
[2] Automation and Control Institute, TU Wien, Gusshaussstrasse 27-29, 1040 Vienna, Austria

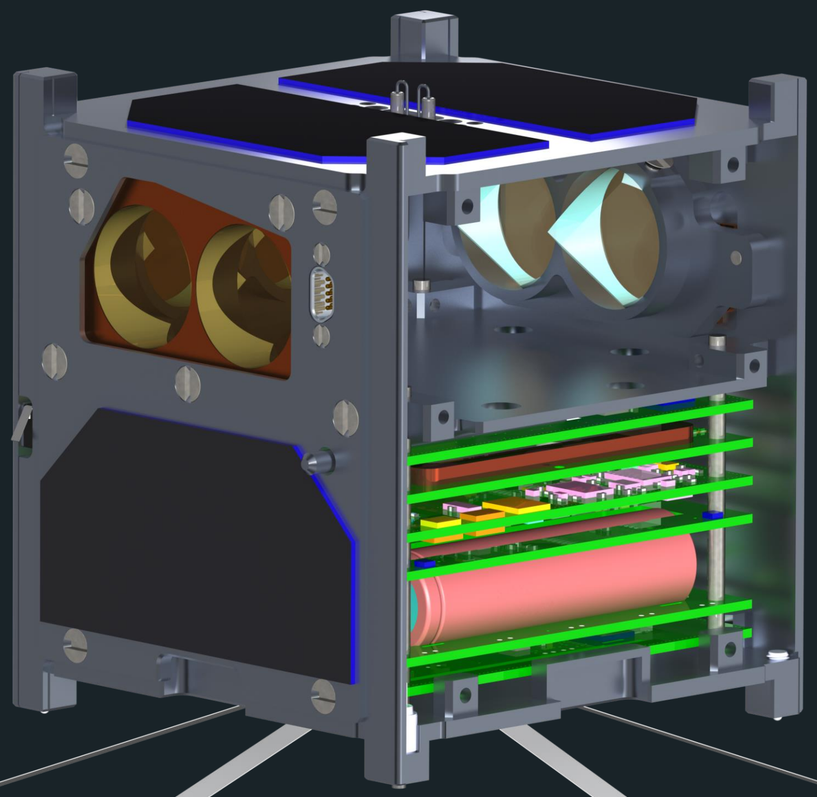
Acknowledgments

This work was funded by the Austrian Ministry for Innovation and Technology (BMVIT) under the scope of the Austrian Space Applications Program (project numbers 848000 and 854050).

Additionally, this work was funded by the Austrian Research Promotion Agency (FFG).

Reflective FSO communicaton principle



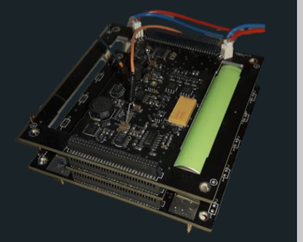


Mission

Modulating retro-reflectors (MRR)

- LCD modulators from 3D-shutter glasses
- The optical ground station (OGS) illuminates the satellite with a powerful laser beam
- Corner cube retro-reflectors at the satellite reflect the incident light back to the OGS with out any moving components
- The reflected laser beam is modulated by the MRR
- Ground station receives the modulated beam

EPS



- Stack of four PCBs
- 2 Li-Ion batteries included
- Only discrete components
- No microcontroller/software
- Charging and thermal battery management
- Maximum power point trackers
- Current and voltage monitoring and measurement

Communication

- Fully redundant
- Double V-Dipole
- Antenna improves aerodynamic stabilization
- Send experimental data to CubeSat
- Transmit beacons to amateur RF stations

OBC

- Controller: ATMEGA1280
- Memory: FRAM, MRAM
- Sensors: 2 Magnetometers, 2 Gyroscopes, Temperature
- Latch-up protection
- Realtime clock, hardware watchdog
- Simple design with discrete components for maximum lifespan under space conditions

ADCS

- Custom made magnetorquers
- B-dot controller for detumbling
- Aerodynamic stabilization for maximal simplicity
- Satellite‘s design ensures stabilization in X and Y
- 360° MRR assembly ensures that one MRR always faces Earth

Further information about DISCO One
https://spaceteam.at/cubesats/disco-one/

Further information about related research projects
https://www.acin.tuwien.ac.at/project/satcomscope/
https://www.acin.tuwien.ac.at/project/tracsat/