26th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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COMMISSIONING OF THE OPTICAL COMMUNICATION DOWNLINK SYSTEM OSIRISV1 ON THE UNIVERSITY SMALL SATELLITE "FLYING LAPTOP"

Abstract

The small satellite "Flying Laptop", launched in July 2017, was developed and built by graduate and undergraduate students at the Institute of Space Systems of the University of Stuttgart with support from the space industry and research institutions. The satellite is operated entirely by a student team using the University's ground station and mission control infrastructure. At a mass of 110 kg, it features a three-axis stabilised attitude control system (ACS) with two star tracker (STR) and four reaction wheels as main actuators. The payload includes an AIS receiver for ship tracking, a multispectral camera system and a wide-angle camera. Two payload downlink systems are integrated, a conventional downlink system in the ham-radio S-Band with 10 Mbit/s data rate and the optical communication system OSIRISv1, provided by the German Aerospace Center (DLR), transmitting at a data rate of up to 200 Mbit/s. The OSIRISv1 system includes two independent laser sources, whose colliminators are hard-mounted on the optical bench along with the satellite's camera systems. The STRs are used as the only attitude reference, requiring the whole satellite to precisely point to the optical ground station in open loop.

The required pointing accuracy to operate the optical communication system was not reached at the time of launch. Only after an on-board software update in mid-2018 the satellite's attitude determination and control pointing capabilities were significantly improved and the pointing requirement of less than 150 arcseconds deviation during a direct pass over a target was met. Improving the ACS was not the only step for a successful commisioning of the optical communication system. Precise knowledge of the two

laser colliminators' orientation is mandatory to establish a link. Before launch, their orientation relative to the cameras was determined by taking images of the laser spots in the clean room using detector cards. Once in orbit, calibration targets on ground were used to detemine the camera orientation and therefore the pointing of the colliminators relative to the satellite body system. An in-orbit calibration campaign commanding different search patterns lead to the first signal aquisition on 17th of August 2018 with DLRs optical ground station in Oberpfaffenhofen. During subsequent passes stable links with durations of up to 10 minutes were established. Further experiments with international partner institutions are ongoing.

This paper gives an overview of the mission planning and operations aspect in handling a LEO to ground optical downlink system.