SPACE OPERATIONS SYMPOSIUM (B6)
New Space Operations Concepts and Advanced Systems (2)

Author: Mr. Harald Wojtkowiak
University Wuerzburg, Germany

Mr. Oleksii Balagurin
University Wuerzburg, Germany
Mr. Kirill Djebko
Germany
Mr. Gerhard Fellinger
University of Würzburg, Germany
Mr. Tobias Greiner
University Würzburg, Germany
Prof. Hakan Kayal
University Wuerzburg, Germany
Mr. Alexander Schneider
University of Würzburg, Germany
Mr. Tobias Schwarz
University Wuerzburg, Germany

AUTONOMOUS MISSION OPERATION ONBOARD NANO-SATELLITE SONATE

Abstract

This paper describes our approach for autonomous mission operations onboard our nano satellite named SONATE (which is completely funded by the German Aerospace Center, DLR, FKZ: 50RM1606) to be launched in Q1/2019. With envisaged key characteristics such as a mass of approximately 4 kg, a power budget ranging from 4 W to 6 W and conforming to the triple cubesat standard dimension-wise (30x10x10 cm), SONATE has to be put into the overall group of small satellites. The primary objective of SONATE is the demonstration of novel key technologies, especially the required functionality for autonomous mission operation. In contrast to our autonomous approach, planning and scheduling of activities for conventional satellites is done on the ground. This way the output of these processes are ordered command sequences, which and are uploaded to the space segment via a satellite link. The onboard computer of the satellite is responsible for command execution. In order to change the behavior of the satellite, the conventional approach requires the onboard command sequence to be updated. This can usually only be done with an upload of commands when in range of ground station and requires in the best case some seconds, in the worst even some hours. Our autonomous approach bypasses these handicaps by generating the required behavior by changing command sequence directly onboard the satellite. This new technology enables new chances for satellite payload utilization whenever quick reactions are required. Envisaged applications are for example the observation of lightning effects in the Earths atmosphere or the detection and tracking of moving objects like meteors. The key component in SONATE making this possible by providing the required autonomous functionality is ASAP which was formerly developed and also completely funded by the German Aerospace Center (DLR, FKZ: 50RM1208). This paper focuses on the two main components of ASAP that implement the autonomous functionality. The first one is APS, the Autonomous Planning System, which covers aspects like decision finding, scheduling, command translation and synchronization of command sequences with the onboard computer of the

satellite. The second one is ASS, the Autonomous Sensor System, which is responsible for detecting and classifying natural phenomena and events. It provides essential meta data to the APS as an input for the decision process. In this paper we intend to describe the advanced capabilities of ASAP by introducing an experimental scenario which will be part of the SONATE mission.