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PREPARING SONATE FOR AUTONOMOUS CONTROL THROUGH ASAP

Abstract

SONATE is a 3U-CubeSat technology demonstrator mission for highly autonomous payloads currently under development at the Professorship of Space Technology at the University of Würzburg and scheduled for launch in 2019. One of SONATE's primary objectives is to verify the key elements of the autonomous sensor and planning system (ASAP) on-orbit. The general benefits of the high degree of autonomy implemented by ASAP are twofold. Firstly, it allows new satellite applications where fast response to external events (e.g. meteor entry into Earths atmosphere for Earth Observation Missions) is required. Secondly, it reduces the overall mission costs by moving workload from the operator to the satellite itself. To complete the verification of ASAP in a closed loop manner, ASAP needs to take over control of the satellite by manipulating SONATE's active command list. However, the demonstration of the highly autonomous functions shall not put extra risk on the SONATE mission as a whole and especially the satellite's other payloads. In order to combine the high degree of autonomy required for the verification of ASAP with the common requirements of a technology demonstrator mission accommodating also other payloads, special measures must be taken. Those measures, which are presented in detail with this paper, affect the verification process of ASAP itself, the onboard data handling system (OBDH), and the mission operations of SONATE. They include different check-out levels for the autonomous functionalities of ASAP, protective measures of the OBDH against unauthorized attempts of ASAP to control the satellite, new concepts for the mission planning process on ground, and directives for the mission operations on ground. The different check-out levels range from LEOP procedures common for every payload, through experiments during which ASAP runs but the plans are not executed, to finally full autonomous control of SONATE through ASAP. The protection of the OBDH is implemented by dedicated states in which the OBDH accepts commands from ASAP as well as a whitelist of commands to be accepted. Both for the mission planning process and mission operations on ground, new concepts had to be developed for this transition from classical operations towards full autonomy. We finally conclude that the set of those measures is sufficient to combine both worlds of classical operations and the increasing on-board

autonomy for satellites and that thus they allow the on-orbit verification of ASAP without putting extra risk onto the SONATE mission.