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ASAP: AUTONOMOUS ONBOARD MISSION PLANNING

Abstract

Usually the activities of a conventional satellite have to be planned during operation in advance on ground by an expert team. They use specialized scheduling software which do not only take into account the activities the satellite is going to do but also other aspects of satellite mission planning like available resources and constraints of the satellite and its sub-systems. The result is a mission plan for the satellite consisting of sequences of commands for the onboard computer, the controlling instance of the satellite. This mission plan is uploaded via telecommands and executed onboard at due time.

This approach has a major drawback. It is not possible to change the mission plan of a conventional satellite quickly, because it would include transmissions of telecommands which infers some latency. This circumstance hinders satellite applications, where quick reactions to short-lived events are required.

In order to enable future satellite missions, where a quick response on an observed event is necessary, the development of a new autonomous image sensor with an integrated autonomous mission planner is ongoing at the University of Würzburg which is funded through the German Aerospace Center (FKZ 50RM1208) by the Federal Ministry of Economics and Technology (BMWi). The aim is to use such a system onboard of nano satellites in the future to enable autonomous fast time responses to short-lived optical phenomena. Furthermore the system can relieve the onboard computer of the satellite by providing scheduling capacities and mechanism.

The hardware of ASAP has already been designed and manufactured and is now thoroughly tested. The software will soon enter critical design phase.

The focus of this paper lies on the autonomous planning capability of ASAP. It provides three functionalities. First, it has to conclude reactions to events in form of satellite activities to be planned. This functionality has to implement some decision-making capabilities. Second, the activities to be planned have to be scheduled. Additional aspects like satellite resources and constraints have also to be taken into account. A scheduler performs this task. It generates satellite mission plans which are ordered sequences of satellite commands. Third, the mission plans generated by ASAP have to be synchronized with the existing command list of the onboard computer of the satellite. A special protocol must be created in order to confer bidirectional changes in the mission plan.