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ON IMPROVING AN EMBEDDED SOLUTION FOR THE ASAP AUTONOMOUS PLANNING SYSTEM

Abstract

ASAP is an autonomous sensor and planning system developed at the Professorship of Space Technology at the University of Würzburg. The main components have been integrated into the SONATE nanosatellite, which is scheduled for launch in 2019. Equipped with a highspeed optical sensor, ASAP allows the detection and classification of transient events, like meteors entering the Earth's atmosphere. The planning system is a highly configurable component providing higher autonomy by generating command lists based on the actual satellite state. This allows fast reactions to events, which would not be possible in the classical mission operations. ASAP currently uses FPGA technology. It enables the image processing to work at very high framerates, whereas it limits the available computational resources and frequency of the softcore processor the planning system runs on. Moreover, the scheduling unit of the planning system uses a branch and bound algorithm, whereat each iteration consists of solving a linear program using the Simplex algorithm. Due to the complexity of the algorithm, scheduling is computationally quite expensive. In the scope of this paper we present a possible alternative novel approach to overcome the above limitations by implementing the planning system on a dedicated microcontroller, and more importantly, by developing an improved scheduling algorithm. To do so, we consider sparse matrices as efficient data structures, LU factorizations, revised simplex algorithms and further mathematical concepts. We are closing by evaluating the improvements on the basis of the general concept, as well as typical use case scenarios, and by discussing further possibilities to improve the planning system for an autonomous mission operation.