Paper ID: 32618
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23rd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Mr. Alexander Kleinschrodt
University of Würzburg, Germany, kleinschrodt@informatik.uni-wuerzburg.de

Mr. Nikolai Reed
University of Würzburg, Germany, nikolai.reed@gmx.de
Prof. Klaus Schilling
University Wuerzburg, Germany, schi@informatik.uni-wuerzburg.de

A COMPARISON OF SCHEDULING ALGORITHMS FOR LOW COST GROUND STATION NETWORKS

Abstract

In parallel to the rising development and launch of pico- & nano-satellites in the recent past, a similar boom in the development of academic ground stations occurred. Academic ground stations, in contrast to commercial ones, are mostly composed of cheap COTS components and are usually operated by student teams. A ground station is generally used by the satellite developers to individually gain access to their satellite in space. To achieve this the ground station's antenna system needs to track the satellite while it is in reach, thus only one satellite can be tracked by a ground station at any given time. In the recent years ground station networks have become more and more important. By combining individual ground stations into a network and sharing joint resources between several geographically spread locations contact times to the satellites can be dramatically increased. In such a network of ground stations the problem of planning and scheduling contact and communication times is a major field of research. The problem class related to the general problem of assigning a ground station network to several satellites is associated to the so called *Multi Resource Range Scheduling Problem* (MuSRRSP) and is classified as NP hard, meaning that there is currently no algorithm for finding the optimal solution in an affordable amount of time.

Until now the problem has been mainly investigated from the perspective of commercial satellite missions and professional agency operated networks of ground stations. However these networks have significantly different designs, architectures and operational concepts. They therefore impose different requirements to the scheduling concepts than the non-commercial academic networks and hence are not directly transferable to the field of CubeSats. This work presents a generic formalization of the scheduling problem. A special framework for implementing scheduling scenarios was developed and will be introduced in the beginning. A description of the scheduling problem especially tailored for academic ground station networks is given and it will be outlined how this was defined in the framework. Several well proven scheduling approaches known to have good performance on commercial scheduling problems - mainly weighted greedy heuristic scheduler and genetic algorithm - have been implemented and tested with respect to their performance in typical CubeSat application scenarios of academic GSNs. Different exemplary cases are presented and used to characterize the performance of the scheduling algorithms.