SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellite Operations (3)

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THE POTENTIAL OF GROUND STATION NETWORKS LIKE GENSO FOR MULTI-SATELLITE PROJECTS LIKE QB50

Abstract

Nano- and pico-satellite technology enables the deployment of several cheap satellites of comparatively low complexity in orbit for performing distributed measurements which would be too expensive using common small satellite technology. A high distribution and redundancy of the measurement instruments in such constellations allow for several satellite losses before a mission fails. The most promising academic satellite swarm project in the near future is QB50.

May both the price and the redundancy make such constellations attractive, they also have a significant disadvantage: the low power budget of the satellites only allows for weak, low-bandwidth communication links. As a consequence the mission data return from such missions is low.

A possibility for significant increase of mission data return in multi-satellite projects like QB50 are large-scale global ground station networks like GENSO (the Global Educational Network of Satellite Operations), a project under the auspices of ISEB (International Space Education Board). Ground station networks interconnect stand-alone ground stations in order to join their hardware capabilities and communication horizons to drastically enhance the communication duration between satellite and ground.

It is considered self-evident that ground station networks will have a strong impact on the mission data return of virtually all current and future non-commercial space missions, but no empirical studies investigating the impact of ground station networks like GENSO on satellite swarm projects have yet been performed. This paper determines and verifies for the first time the strong impact of such networks on multi-satellite missions.

Multiple possible QB50 constellations in different mission progress stages have been simulated and the impact of ground station networks of different sizes on the increase of mission data return has been investigated. Furthermore, the differences in optimization efficiency of such networks between single space missions and multi-satellite missions are discussed. Also, the impact of different orbit heights on the optimization possibilities is investigated. Consequently, general rules for the relation between the network and satellite constellations and the possible optimization on mission data return are derived.

The performed research empirically determines and verifies the strong impact of global ground station networks on the mission data return of multi-satellite projects. All investigations have been performed and validated using a novel framework for generic ground station network scheduling, simulation, and optimization.