Paper ID: 14995
oral
student

19th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Ms. Eirini Komninou
University of Strathclyde, United Kingdom, eirini.komninou@strath.ac.uk

Dr. Massimiliano Vasile
University of Strathclyde, United Kingdom, massimiliano.vasile@strah.ac.uk
Dr. Edmondo Minisci
University of Glasgow, United Kingdom, edmondo.minisci@glasgow.ac.uk

OPTIMAL DYNAMIC OPERATIONS SCHEDULING FOR SMALL-SCALE SATELLITES

Abstract

A satellite's operations schedule is crafted based on each subsystem/payload operational needs, while taking into account the available resources onboard. A number of operating modes are carefully designed, each one with a different operations plan that can serve emergency cases, reduced functionality cases, the nominal case, the end of mission case and so on. During the mission span, should any operations planning amendments arise, a new schedule needs to be manually developed and uplinked to the satellite during a communications' window. The current operations planning techniques offer a reduced number of solutions while approaching operations scheduling in a rigid manner. Given the complexity of a satellite as a system as well as the numerous restrictions and uncertainties imposed by both environmental and technical parameters, optimising the operations scheduling in an automated fashion can offer a flexible approach while enhancing the mission robustness. In this paper we present Opt-OS (Optimised Operations Scheduler), a tool loosely based on the Ant Colony System algorithm, which can successfully solve the Dynamic Operations Scheduling Problem (DOSP). The DOSP is treated as a single-objective multiple constraint discrete optimisation problem, where the objective is to maximise the useful operation time per subsystem onboard while respecting a set of constraints such as the feasible operation timeslot per payload or maintaining the power consumption below a specific threshold. Given basic mission inputs such as the Keplerian elements of the satellite's orbit, its launch date as well as the individual subsystems' power consumption and useful operation periods, Opt-OS outputs the optimal ON/OFF state per subsystem per orbital time step, keeping each subsystem's useful operation time to a maximum while ensuring that constraints such as the power availability threshold are never violated. Not only does Opt-OS provide the flexibility needed for designing an optimal operations schedule on the spot throughout any mission phase, but it also gives the ability to automatically schedule operations in case of emergency as well as applying Adaptive Operations Scheduling (AdOS). AdOS can be applied in novel technologies such as smart passive Attitude Control, utilising the satellite's cabling as magnetotorquers for orienting the satellite around bodies with existing magnetic fields.