Paper ID: 10416
oral
student

15th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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MULTI-SATELLITE, MULTI-STATION TT&C SCHEDULING USING MULTI-OBJECTIVE EVOLUTIONARY ALGORITHMS

Abstract

As the small satellites technologies development rapidly, more and more small satellites are running in orbit to complete various tasks, which even compose satellites constellations to finish more complex missions. In order to running successfully, TTC (telemetry tracking and command) of small satellites need be considered. TTC (telemetry tracking and command) workloads are too much for ground stations to afford. The satellite TTC scheduling technology is an effective method to settle this problem, which is able to improve the operation efficiency of ground stations. Many studies have been made on TTC scheduling problem, while few of them focus on multi-satellite multi -station TTC scheduling using multi-objective optimization technique. The purpose of this paper is to propose a new scheduling method using multi-objective evolutionary algorithms for multi-satellite and multi-station TTC problem. The multi-satellite multi-station TTC scheduling problem is formulated as a multi-objective optimization model, where the variable that determines whether a ground station connects a satellite when the satellite appears in the ground station's field of view is chosen as the design variables, the objective functions include the sum of the satellite TTC priority, the ground station use priority, ground station efficiency and the maximal sum of the longest TTC arcs. The constraints including the time windows of ground station seeing the satellite and the requirement of minimum transition duration between two neighboring satellites of a ground station are considered in the model. Two popular and well-applied multi-objective evolutionary algorithms, NSGA-II and SPEA-II are employed to solve this multi-objective problem and their performances are compared. The proposed method is applied to several TTC scheduling problems with different number of stations and satellites. The results show that the proposed TTC scheduling model is effective, and the proposed method can obtain the Pareto solutions which can quickly demonstrate the tradeoffs between different TTC schemes.