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MULTI-SATELLITE ON-BOARD BEHAVIOUR PLANNING USING ADAPTIVE GENETIC ALGORITHM

Abstract

With the increasing demand on space mission, there are more and more calls for multi-satellite missions. As the number of satellites increases, generating command operations can be a laborious procedure which not only requires specialized knowledge from operators but also takes too much time for command transmission. Due to time consuming and human resources' limitations, it's hard to manually remote operations for a multi-satellite system. This paper propose a solution for this problem. By developing an on-board intelligence system which use artificial intelligence techniques to help ground mission control executing mission operators and payloads' planning automatically.

This paper uses OLFAR mission as a reference. The main objective of OLFAR is to explore the universe in the hitherto unknown very low frequency (below 30 MHz) electromagnetic spectrum range at low Moon Orbit (about 300km). One OLFAR architecture foresees one Mother Satellite which carries eight Daughter Satellites, after reach the destination orbit, Mother Satellite will release all the Daughter Satellites. The on-board computer on the mother satellite use adaptive genetic algorithm, considering mission requirements and state information transferred from other daughter satellites, and determines appropriate behaviours to achieve goals. Generating ab optimal time planning for these selected payloads will satisfy operation constraints. According to some shortcomings of adaptive genetic algorithms, we propose to use hybrid dynamic mutation strategy to replace original mutation strategy. The modified adaptive GA has better performance on both convergence time and avoid local optimal.

This automated on-board planner can help people who are not an expert to involve in this process. Simulation results confirmed that this tool can quickly react mission requirements and generate optimal plans for each satellite in system to achieve mission goals. Modified adaptive GA can help on-board computers to better handle complex missions in shorter time. This in turn brings us the opportunities to utilize this method in more sophisticated and more authentic space missions.