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A FAST-RESPONSE LAUNCH PLANNING METHOD FOR SMALL SATELLITES

Abstract

Air-launched rockets provide a significant advantage in fast-response launches by cutting down launch waiting time and reducing the time needed for orbital deployment. The air-launched rocket's fast-response launch mission planning is studied to improve the performance of fast-response launches to "launch on demand at any time" and "like an airplane lift-off rate." First the analytical solution for the launch window of the air-launched rocket is deduced. Launch orbits with varying launch point latitudes are obtained through the Newtonian iterative fast extension orbit design. With the help of the equivalent phase of the virtual satellite on the target orbit, the available launch time and the coordinates of the launch points in the period of concern are solved. Second, a multi-satellite fast-response deployment mission planning method is proposed, considering constraints including the launch platform's maneuverability and drop zone safety of the rocket sub-stage. Multi-layer coding characterizes the task allocation matrix that describes satellites, launch windows, launch sites, launch platforms, and the time sequences between launch activities. Three rules determine the assignment of the mission: the assignment rule is based on task priority; the exit rule is based on window dependency and the insertion rule is based on task congestion. Finally, a typical Walker constellation supplement fast-response deployment is used to evaluate the mission planning algorithm. Even if the difference between the RAAN and the argument of latitude of the target orbit of the satellites both reaches 180 degrees, the mission can be accomplished by air-launched rockets in at least two hours, with a launching window that can be reached by the carrier aircraft is extend up to seven or eleven hours, and the satellite does not require phase adjustments in-orbit. The advantages of the fast-response launch planning method are evaluated quantitatively compared to the terrestrial launch site. Mission planning can effectively manage practical engineering constraints such as carrier aircraft mobility range and scheduling, rocket sub-stage drops zone safety, etc.