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TWO NEW LAUNCH PLATFORMS FOR AIR-LAUNCHED ROCKETS

Abstract

The characteristics of high efficiency, flexibility, and miniaturization of air-launched rockets meet the requirements of low-orbit small-satellite launching, but the existing launch platform of modifying subsonic aircraft does not achieve the optimal performance of the aircraft-rocket combination. New launch platforms are required to improve the launch efficiency of air-launched rockets. Firstly, the influence of launch parameters, such as altitude, Mach number, and flight path angle, on the payload efficiency of the air-launched rocket was analyzed. Then, two new launch platforms were proposed. The first was a combined power high-altitude unmanned aerial vehicle (UAV), and the second was a recoverable unmanned platform carried by a subsonic aircraft. The combined power high-altitude UAV was powered by an aviation engine and a liquid oxygen kerosene rocket engine. Schematic of configuration and main structural parameters were given. The aerodynamic characteristics of the combined high-altitude UAV at the altitude between 12km and 30km were analyzed. The parameters of the liquid oxygen kerosene rocket engine and the angle of attack were taken as design variables to optimize the maximum payload efficiency of the combined power high-altitude UAV. A recoverable unmanned platform carried by a subsonic aircraft was the basis of a new combined launch platform. The main structural parameters and launch procedure were given. The angle of attack was designed by analyzing aerodynamic characteristics and optimizing the liquid oxygen kerosene rocket engine's parameters. Finally, taking the launch of a 20,000 kg air-launched rocket as an example, the flight trajectory of the liquid oxygen kerosene rocket engine's working section was provided, and the contributions of the two new launch platforms as a zero-stage reusable power in terms of payload efficiency and economic efficiency were quantitatively analyzed. With a single launch, the combined power high-altitude UAV loses roughly 29% of its payload capacity, but for 10 recoveries, it saves nearly 13% on launch cost per kilogram. The payload capacity of recoverable unmanned platforms is increased by about 28%, and the launch cost per kilogram of payload is decreased by approximately 47%. The analysis demonstrates that the application of the two new launch platforms can significantly improve the payload efficiency and reduce the launch cost of air-launched rockets.