IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Launch Vehicles in Service or in Development (1)

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RESEARCH ON RECOVERY TECHNOLOGY DEVELOPMENT STRATEGY OF LAUNCH VEHICLE IN CHINA

Abstract

The launch vehicle is one of the effective ways to reduce the cost of entry space. A reusable launch vehicle is a developing direction of launch vehicles, which can meet the large-scale, cost-effective access to space. This paper studies the technological development of launch vehicles and analyzes various recovery schemes nowadays. We propose future development strategies for recovery technologies of reusable launch vehicles. Given the existing rocket configuration, three strategies are employed for recovery. Strategy 1 is that the technologies of parachute landing and grid rudder control are used as the primary recovery techniques. The rocket booster and first sub-stage are recovered by parachute landing, which solves the problems of the accurate control landing area of the boosters and first sub-stage and flight area safety. A grid rudder is used to adjust the attitude of the substage to steady-state flight for recovery, and the navigation guidance and control system guides the substage to fly and land in the target landing area. Strategy 2 is vertical recovery mode which selects the configuration of a hydrocarbon engine based on liquid oxygen. In the landing stage, the landing leg buffer mechanism is deployed to complete the vertical and smooth landing, similar to the Falcon rocket recovery form. New types of the launch vehicle will use the recovery mode. The recovery scheme of the launch vehicle with boosters is that the core stage integrated with bundling boosters uses vertical take-off and landing. Strategy 3 is an aerial recovery in that the rocket sub-stage is captured by an aerial platform (usually a helicopter or airship) equipped with a hook or capture net. Through three development strategies, we shall gradually realize the reusable development of China's existing rocket configuration. The new configuration of reusable space vehicles mainly includes lift reusable space vehicles. In 2021, China conducted its first demonstration flight of a suborbital reusable space vehicle, which achieved complete success. The combined power technology of space vehicles also includes turbine-based combine cycle (TBCC), rocket-based combined cycle (RBCC), turbo-aided rocket-augmented ramjet combined cycle engine (TRRE), and pre-cooling air turbo rocket combined cycle (PATR), etc. Based on these technological developments, China's space industry will achieve the goal of large-scale and cost-effective access to space in the future.