MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations (IP)

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FIRST STAGE AERODYNAMIC OPTIMIZATION OF THE LAUNCH VEHICLE IN LANDING AREA CONTROL TECHNOLOGY

Abstract

With the increasing trend of launch missions, the first stage landing area issues become the key restraining factor in the flexibility of launch missions. The common and traditional method is to conduct safety analysis and forecast on the landing area and search the debris roundly. Nevertheless, great potential safety hazard and resources waste exist. Therefore, the precise control of the first stage landing area is a key technology. The purpose of this paper is to propose a suitable control method for the first stage landing area based on the aerodynamics considering domestic and abroad development.

The first stage landing area control includes negative parachute landing and positive precise control. Negative parachute landing realizes attitude control and landing stably through the parachute. However, this scheme is heavily dependent on ground winds and the control precision is far from satisfactory. On the contrary,positive precise control is relatively independent and possesses higher trajectory and attitude control precision with the help of small engines, air injection mechanism and rudders. In this paper, a shape-maintaining attitude control method of the first stage is put up. The aerodynamic shape is optimized and the normal working environment temperature of the system is retained through the inflatable thermal shield under high Mach number reentry situations. Furthermore, aerodynamic stability is enhanced through lattice rudders and the controlling torque is output with the support of the aerodynamic force. The result shows that this scheme is of perfect aerodynamic stability and can maintain good thermal environment so that the first stage attitude stability and the landing area precise control can be easily realized.

It is concluded that the landing area can be greatly reduced and the safety can be guaranteed based on the aerodynamic optimization. Furthermore, manpower and resources can be saved and the dependence of the launch on the surroundings can be reduced so that the high density launch requirement can be satisfied and the adaptability of the launch mission can be improved.