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THE IMPROVEMENT IN DOWNRANGE OF THE FLY-BACK BOOSTER BY RE-INGITION AFTER SEPARATION

Abstract

These days, there is increasing demand for the utilization of space for business and research. To realize space mass transportation we have to reduce space transportation cost dramatically. But it is hard to cut cost significantly under the existing expendable launch systems. So, reusable launch systems are needed to reduce cost of transportation per a launch.

There are various concepts of reusable launch vehicle (RLV). For example, SpaceShipTwo has a reusable mother ship "WhiteKnightTwo", which is horizontal takeoff and landing (HOTOL). This paper focuses on full reusable Two Stages To Orbit (TSTO) which is Vertical Takeoff and Vertical Landing (VTVL). This vehicle doesn't have wing structure and uses liquid propellant rocket engine. The advantages of VTVL vehicle are more payload ratio than HOTOL and compact launch site. After separation of the orbiter (second stage), the fly-back booster (first stage) needs to come back the launch site. Because of low L/D, however, the fly-back booster isn't able to return the launch site in case it is too far away from the launch site.

To improve short downrange, a new approach is taken which is re-ignition of the booster's engine. After separation of the orbiter, the booster's attitude changes by RCS. After that, the booster's engine fire for a few minutes to change the coasting orbit. When the booster returns to launch site, it makes a soft landing by the rocket engine. This paper describes the result of evaluation of parameter optimization to maximize the orbiter's payload.