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TRADE-OFF STUDY AND THRUSTER SYSTEM TEST OF REACTION CONTROL SYSTEM FOR REUSABLE ROCKET BOOSTERS

Abstract

For fly-back type reusable rocket boosters, such as first stage of SpaceX Falcon9, reaction control system (RCS) is required not only for vehicle attitude control but also for quick turn-around maneuver to fly back to the launch site. For the attitude control, conventional pulse operation would be used, but for the quick turn-around maneuver, continuous operation with high thrust would be necessary to achieve efficient return to the launch site or to prevent the degradation of launch performance. Because such requirement is important but peculiar to reusable booster stages, trade-off study and optimization are necessary. Therefore, various kinds of RCSs, including monopropellant, bipropellant, cold gas, gas/gas mixing combustion, liquefied gas, integrated system (applying main propellants), and so on, were listed up and then evaluated based on criteria such as system wet mass, toxicity, reliability, cost, and technical feasibility. Following the trade-off study, the best RCS candidate was picked up and thruster test campaign including propellant feed system was conducted under vacuum, high altitude and atmospheric conditions. The result showed the proposed RCS was feasible and promising for reusable booster stages.