

SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (5)

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AERO-SPIKE AND RBCC ENGINE SYSTEMS FOR FUTURE SPACE TRANSPORTATION VEHICLE

Abstract

Feasibility study on future transportation vehicle (termed as reference system) is undergoing at Japan Aerospace Exploration Agency, setting the target on reusable, manned launch vehicles. Two staged vehicle configuration to low earth orbit is the final target of the current study, while point-to-point high-speed transportation using the same vehicles is also under consideration for near-term application. For short-range transportation, system study on a rocket engine powered vehicle is undergoing, which should equip reusable rocket engine with so-called altitude-compensating nozzle (aero-spike nozzle) to meet the specific impulse requirements. This vehicle will be used with modifications for the second stage (termed as orbiter) of the TSTO-RLV. For long-range transportation, system study on a RBCC (Rocket Based Combined Cycle) engine powered vehicle is undergoing, because a very high specific impulse is necessary to make dry-weight to take-off weight ratio reasonable. This vehicle will be used for first stage (termed as booster) of the TSTO-RLV. Detailed analysis on the reusable rocket engine for the in view of performance, cooling capability as well as life-time assessment, and structure / weight was conducted to show that relatively small size resulted in poor sea-level performance due to base drag and engine wall overheat due to severe heating condition. The engine weight was also found to be too large to meet the requirement of the orbiter vehicle. Sizing and performance prediction on the RBCC engine was also conducted together with the booster vehicle performance prediction to find that a ballistic trajectory flight resulted in a longer down-range than hypersonic cruise flight. Engine system thermal balance analysis as well as structure / weight analysis were also conducted. All these results will be reported in the presentation.