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Title

Results of Hot-fire Testing of 30kN LOX/Methane Full-expander Cycle Engine

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Abstract

Methane/Liquid oxygen (LOX) rocket engines are promising candidates for propulsion systems of various future space transportation systems such as reusable launch vehicles, orbital transfer vehicles and space exploration vehicles due to the larger density compared with liquid hydrogen, the higher specific impulse (Isp) compared with kerosene and the good storability. Various methane/LOX rocket engines have been developed mainly for reusable launch vehicles such as SpaceX Starship, Blue origin New Glenn and RocketLab Neutron. PROMETHEUS, which is a methane/LOX rocket engine designed for low-cost, flexibility and reusability is also under research and development in Europe [1].

Japan Aerospace Exploration Agency (JAXA) had started the research and development of methane/LOX propulsion system in early 2000's. Since 2013, JAXA has been studying a 30kN class high-performance methane/LOX rocket engine system, which adopts the full-expander cycle to achieve the high Isp. A series of component tests such as injector tests, regeneratively cooled combustion chamber tests and a single-shaft turbopump tests were conducted from 2017 through 2019[3-5]. Technical feasibilities of components such as combustion efficiency and combustion stability of the injector, cooling performance of the combustion chamber and turbopump system performance which can achieve the target Isp of 370 s were demonstrated through the series of component tests, and component characteristics were obtained to evaluate the system level feasibility.

It is demonstrated that the characteristics of major components which were obtained in the component tests satisfied the engine system requirements, and it is feasible to move to the engine system integration phase to demonstrate overall system performances of the methane/LOX engine. Therefore, engine system integration tests were started in 2021 to demonstrate engine system level performances and technical feasibility of the methane/LOX full-expander cycle engine. This study reports the results of the engine system integration test campaigns.

References

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