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Title

Cryogenic Upper Stage Development for Future Korean Small-Lift Launch Vehicles

Authors

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Abstract

A three-staged Korea Space Launch Vehicle (KSLV-II) capable of lifting more than two tons to low Earth orbit delivered its first payload in 2022, and a national launch service will be established by the Government and subsequently operated by a private company. While finishing up the development, KARI initiated a preceding research project in 2020 to examine potential derivatives of the KSLV-II technology for small satellites launch as well as to explore cost-cutting technologies. For low-cost access to space, a two-staged vehicle that can inject 500kg of payload into 500km sun synchronous orbit was proposed as a candidate. To extract the required performance out of the two-stage configuration, a cryogenic upper stage has been chosen, and perhaps more importantly, an additive manufacturing technology has been widely adopted in the design of rocket engine thrust chamber, injector head, and turbopump rotors and housings for weight reduction as well as for part count and interface reduction, ultimately with a goal to bring down development and productions cost.

A system-driven technology selection was made for the cryogenic upper stage design, and some of the key technologies were incorporated into a national program in 2021 that supports a range of industry-led projects on the upper stage technology, including common bulkhead propellant tanks, interstage umbilical systems, and integrated avionics. In addition, a national program called FOCUS (Fostering Overall industry Competencies for Upper Stage of small launcher) was initiated in 2022 to support private companies that aim to develop an upper stage rocket engine. In parallel, KARI researchers have been developing cutting-edge technologies for an advanced upper stage system, with a focus on additive manufacturing of thrust chamber, injector head and turbopump unit, and providing technical consulting to the industry partners in the course of designing their individual upper stage propulsion systems. In addition, separate national projects to develop a spaceport for commercial use as well to establish a space industry park to incubate rocket startups are underway. These all align well with recently released, Master Plan for National Space Development, which declares that the Government's near-term strategy on liquid rockets-based smallsat-dedicated launch vehicles is to support privately-led development and their commercial launch service. Recognizing the unprecedented growth of small satellite market, several new space companies jumped in to develop a cost-effective small launch vehicle based on their own roadmap.

References

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