IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

Author: Dr. Gwanghyeok Ju
Korea Aerospace Research Institute (KARI), Korea, Republic of, ghju@kari.re.kr

Dr. Kyeong Ja Kim
Korea, Republic of, kjkim@kigam.re.kr
Mr. Cheol-Hea KOO
KARI, Korea, Republic of, chkoo@kari.re.kr
Mr. Su-jin Choi
Korea Aerospace Research Institute (KARI), Korea, Republic of, jin5864@kari.re.kr
Dr. Hoon-Hee Lee
Korea Aerospace Research Institute (KARI), Korea, Republic of, lhh@kari.re.kr
Dr. Bang-Yeop KIM
Korea Aerospace Research Institute (KARI), Korea, Republic of, bangyeop@gmail.com
Ms. SeokHee Lim
Korea Aerospace Research Institute (KARI), Korea, Republic of, shlim@kari.re.kr

NANOSAT-BASED LUNAR MISSION FEASIBILITY STUDY ASSOCIATED WITH SMALL-SIZED LAUNCH VEHICLE

Abstract

The first test launch of KSLV-2 (Korea Space Launch Vehicle) is scheduled in late 2021 after its successful launch with single-stage launch vehicle (LV) only with single 75-tons engine. Overwhelming worldwide demands for small-sized LV become dominant motivated by emerging game-changer smallsats/nanosats. In order to check adaptability scalability associated with nanosats and small-sized LV for feasible lunar mission, KARI recently started feasibility and scalability study in terms of mission trajectory, spacecraft concept design, lunar mission scope and concept of operation, communication visibility, lander pathfinder, etc. Lunar mission trajectory options for trans-lunar injection approach could be selected to optimize affordable payload weight and mission lifetime: direct transfer and weak-stability boundary. Possible lunar mission scope with nanosat is extended to resource prospecting with on-orbit spectrometers for resource element analysis, communication relay, navigation system in the lunar territory. Mini gamma-ray spectrometer is proposed by KIGAM to accommodate nanosat-type lunar orbiter in order to check how to efficiently substitute conventional regular spectrometer used in the previous lunar and planetary missions with better prospecting performance. Conceptual study and prototyping for nanosatellites are being led by KARI to provide a real-time communication relay between the Earth and the lander and rover on the moon surface, where a lot of active lunar robotic landers supported by NASA CLPS program are expected in 2 to 3 years. Nanosat-based navigation system similar to CAPSTONE, which will be launched by the Electron (RocketLab), is conceptually proposed to check feasibility enough to provide positioning, navigation and timing (PNT) information to lunar surface elements as well as lunar gateway. On the other hand, nanosat-based lander pathfinder concept is suggested to demonstrate guidance and navigation technique associated with artificial intelligence (AI) and deep learning, and terrain relative navigation (TRN) on the phase of descent and landing, which is one of the most critical path for lunar landing and urgently in need of actual flight test in the lunar environments. With respect to proposed missions, brief concept of operation scenario are suggested and DTN (delay tolerant network)-wise communication constraints

are analyzed. The outcome of this feasibility study, initially proposed for extending LV applications, could provide insights and motivation to make giant steps towards extending and expediting new space worldwide to the cislunar and deep space territories.