

SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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L.H.A. –LANDER-HOPPER-ASCENDER– A FAMILY OF INTEGRATED LUNAR EXPLORATION
VEHICLES

Abstract

In the frame of the activities, conducted few years ago by Carlo Gavazzi Space, with the support of International Space Pioneers, in preparation of the expected ASI and of the ESA studies on Space Exploration, a rather innovative concept has been developed of an Integrated Lunar Exploration Vehicle. The L.H.A.-Lander-Hopper-Ascender is a family of Integrated Exploration Vehicles for conducting initially robotic operations on the surface of the Moon, and in subsequent times Lunar Human operations. The L.H.A Integrated Vehicle comprises, the function of transferring the payloads from a Lunar orbit to the Lunar surface, the function of ensuring high mobility on the Moon surface through a sequence of jumps and the function to return to the Lunar orbit part of the cargo and the Astronauts. L.H.A is all in one a Lander, an Hopper and an Ascender. The L.H.A. is fully re-usable and is operated with propellants that initially are carried out from the Earth, while progressively it utilizes In-Situ Resources: Liquid Oxygen and Liquid Hydrogen. Different Architectural Scenarios, within which the members of the L.H.A. family can operate, have been taken into consideration, part of an evolutionary process that, starting with short duration and short range fully automatic missions, leads to more complex manned missions operated by a Permanent Moon Base, for which the Hopper mode becomes fundamental to extend the radius of the exploration activities around the Human settlement. The L.H.A Vehicles are extremely versatile; they can be utilized for Moon Scientific Research Activities requiring the exploration of a number of different sites separated by large distances that present a soil morphology very uneven. They can be as well used to conduct field surveys aiming at the initial identification of useful resources; the L.H.A. might also assume a fundamental role in the more future logistic operations, transferring ISPP -In-Situ Produced Propellants - to a Lunar Orbiting Depot to be used in complex inter-orbital flights, including the Mars destination, and/or for feeding the next generation reusable vehicles for commercial LEO-GEO operations. Within the Cargo Compartment quite a different variety of Payloads designed in a Modular-Way can be accommodated. The L.H.A Vehicles turn out to be indeed a very versatile Family of Multi-Missions Reconfigurable and Reusable Exploration Vehicles. Other configurations foresee the transport of conventional Small Rovers that are disembarked from the Hopper, move automatically around the landing site and return back to the Hopper to be transferred to other destinations For Advanced Missions the use of Human Piloted Roving Quads is taken into consideration to enhance the benefit of the exploration through close examination of the surface details, with possibility to collect interesting samples to take back. The main results of some preliminary design at system level of the principal elements of the L.H.A Vehicle Family are reported.