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LUNAR MOBALL NETWORK TO MAP FEATURES OF INTEREST ON THE SURFACE AND UNDERGROUND OF THE MOON

Abstract

The Lunar Moball Network is an intelligent and reconfigurable network of agile and self-powered in-situ spherical robotic-sensors, called Moballs. The Moball are equipped with several low-mass and low-power science instruments and tools, including ground penetrating radar systems, to detect and map volatiles, metals, radiations on the surface of the Moon, as well as underground fractures and structure, such as lunar lava tubes. The Moballs have an elastic, inflatable and self-rigidized structure. This allows for a large number of units to be packed in a mother spacecraft and deployed over a large surface of the Moon resulting in an in-situ map of a wide range of phenomena across a much larger portion of the surface of the Moon compared to the current and proposed insitu exploration systems. The Moballs are equipped with a novel hexa-axle magnetic mechanical control system consisting of three internal perpendicular axes with movable and controllable magnetic weights moving within solenoids. Controlled movements of the magnetic weights (via the solenoids) along each of the three axes can initiate and control the Moball's locomotion (e.g. trajectory and speed). It could also control the Moball's orientation and enable its precise positioning during science investigations. Our previous studies have shown that the Moballs need less than 2 Watts for their mobility on the surface of the Moon. The Moballs are self-powered; numerous smaller solar cell units or flexible thin film solar panels could be integrated into their large elastic and protective shell and structure harvesting the solar light and storing it in their rechargeable batteries. The Lunar Moball Network is envisioned to be a scalable, self-powered, controllable, distributed system that would share tasks intelligently in order to optimize its resources (power, memory, bandwidth, available working sensors, etc.) and the performance of its exploring and sensing responsibilities. Because of its energy harvesting features and being an intelligent resilient system and structure, a Moball Network is capable of long life span missions needed to achieve many of the future space exploration objectives in a cost-effective way, leaving a long lasting sensing and searching infrastructure on the lunar surface.