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LUNAR INTELLIGENT ORBITING NANOSATELLITE SWARM AS DISTRESS POWER DELIVERY SYSTEM FOR INTERSOLAR MISSIONS

Abstract

In the advent of the era of NewSpace technologies redefining our capabilities exponentially in terms of both performance and profitability, an important endeavor to consider is the recently proposed power generation projects on the Moon, ranging from Shimizu Corporation's Luna Ring to the Nuclear Power Stations planned by various Space Agencies and companies. An unaddressed question in this scenario is the effective delivery of the power thus produced to energy demanding missions in space. The development in power systems technologies has significantly increased charge-storage capabilities, rechargeability and chemical life of storage batteries, advanced circuitry technologies for decreasing size and power losses and effective solar panels to produce maximum power for available illumination and significant radiation resistance. It has also given rise to a new range of microwave-based power propagation technologies that help transmit power across long distances. The rise in Artificial Intelligence, Machine Learning and Neural Networks and the development of small but highly effective Guidance, Navigation and Control Systems allows for intelligent control of swarms of many satellites for synchronized operation, and docking and berthing systems have been developed such as the UDPS docking port for physical linkage to facilitate power or fuel delivery. Through utilization of microwave-based power capture technology, COTS Nanosatellite components, custom designed Power and Docking Systems and Artificial Intelligence-based processing and GNC capabilities for Swarm Operations, this paper describes a lunar multi-nanosatellite swarm mission to collect power generated on lunar surface via microwave-beaming and conversion and storage of same to electrical form, followed by delivery in swarm constellations of the same to distress locations in the Intersolar region for ongoing interplanetary or Intersolar missions. The mission architecture and protocols, with the constellation orbital design and simulations, nanosatellite subsystem architecture, power reception, storage and delivery system design and validation, with structural and thermal testing, and the genetic algorithm based automated constellation and trajectory design algorithm has been detailed in the paper. As ambitious as the mission is, with the current availability of disruptive technologies and an opportunity to effectively utilize the power generated on Moon for facilitation of ongoing and future missions, this mission is a novel yet practically feasible endeavour, subject to availability of sufficient necessary resources.