Paper ID: 76047
student

30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

Author: Mr. Mohammed Irfan Rashed
Korea Advanced Institute of Science and Technology (KAIST), Korea, Republic of, irfanrashed@kaist.ac.kr

# DEVELOPMENT OF SUSTAINABLE AUTONOMY OF SMALL SATELLITE CONSTELLATIONS FOR CISLUNAR SPACE

**Abstract**

The CisLunar space is getting busy sooner than expected in the recent trends of NewSpace era. The launches to the Moon carrying rovers to well-defined small satellites and their constellations in Earth orbits performing their tasks as planned. The problem is how these tasks can be automated in synergy with the operators on ground to focus on urgent concerns rather than solving repetitive anomalies. A well-structured mechanism is needed specifically for small satellites (weighing less than 500 kgs) to make decisions on-board and facilitate endured operation for the given lifecycle. The optimal utilization of autonomy is an urgent need to build competitive systems and techniques for this region. In this race towards attaining positions in CisLunar region, small satellites constellations are gaining their spotlight for prominent applications. There is immense necessity to balance resources and cost through creative development of these satellites for a reliable long-term operation and valuable contribution to this region. This research is directed and envisioned towards this aspect and dedicated for development of durable and cost-effective systems through novel techniques. This paper presents the novel methodologies to synergize the autonomy with the human efforts for an integrated operation of small-satellite constellations. For this, a well-aligned, distinct and systematic development of the autonomous techniques and their implementation on orbit and ground is essential. The research addresses some of the most critical issues in real-time operations today and how autonomous systems integrated strategically can be cost-effective and significantly contributing to the mission objectives. The design and development of autonomy is systematically presented covering the major insights of Debris, perturbations (J2 and recent conditions with Solar Radiation Pressure), Space Situational Awareness and Collision Avoidance, orbit decay and strategic maneuvering for a proposed configuration of small satellite constellation commonly functional within the CisLunar setting. These aspects are supported through an alignment of visually graphic demonstration along with parametric analyses through plots. The necessity to place the orbits without obstructing the scientific astronomical research and other missions is presented in detail. This comes with a methodology to maintain minimum satellites in a constellation with an optimal global coverage reducing overall logistics, cost and resources. In conclusion, the discussion on the proposed techniques and their operational and parametric results are detailed with essence of this research in real-time applications (disaster management with LEO and Artemis support with Lunar NRHO). This will be followed by conclusion and significantly researched references with future work.