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# FUTURE OF SPACE TRAFFIC AND DEBRIS MANAGEMENT IN CISLUNAR SPACE

**Abstract**

The current regulatory regimes of space traffic management (STM), space situational awareness (SSA), and space debris mitigation (SDM) are centered around Earth orbits and Earth re-entry. The lack of STM, SSA, and SDM considerations for cislunar space has been primarily due to a lack for more active, relevant stakeholders for the moon. Recent developments in the private sector's involvement in cislunar missions and security conflict for resources on the moon require a renewed focus on these topics for the cislunar domain.

Private missions to the moon can take on greater risk tolerances than government missions. In the last half-decade alone, lunar landers of Beresheet (SpaceIL, 2019), M1 (iSpace, 2023), Peregrine 1 (Astrobotic, 2024), and IM-1 (Intuitive Machines, 2024) have failed to land on the moon successfully. While Peregrine was redirected for atmospheric re-entry, potential failures for lunar missions will result in debris in cislunar space. In particular, cislunar areas of Earth-Moon Lagrangian points, lunar orbits, and lunar surfaces pose grave threats to future missions attempting to navigate cislunar space. This paper looks at the limitations of current legal and regulatory frameworks to address these issues, particularly on the likelihood of proposed multinational schemes like the Artemis Accords to mediate potential hazards successfully.

While the moon is still vast, missions predominantly focus on a few geological features such as the lunar south pole region, bottoms of deep craters, and lava tubes. Plans for crewed missions on the moon go hand in hand with satellite constellations in lunar orbit to provide resilient communications and navigation capabilities. Lastly, lunar orbital stations like the gateway to service lunar surface missions and support Martian missions will further congest the cislunar space. All these factors call for a review of cislunar traffic regimes that include emergency services, communication bandwidth allotment, and best practices for peer safety. This paper looks at risk mitigation and conflict resolution models that could work for cislunar traffic management.

This paper is primarily concerned with SDM and STM practices for cislunar space but is supported by considering future SSA practices for the same domain. Situational awareness, including trajectory planning and analysis, risk calculation, and peer notification, are all included in this paper.