Paper ID: 63556
student

19th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Mitigation - Tools, Techniques and Challenges - SEM (4)

Author: Mr. Paolo Guardabasso
ISAE-Supaero University of Toulouse, France, paolo.guardabasso@isae-supaero.fr

Prof. Stéphanie Lizy-Destrez
Institut Supérieur de l'Aéronautique et de l'Espace (ISAE), France,
Stephanie.LIZY-DESTREZ@isae-supaero.fr

CISLUNAR DEBRIS MITIGATION: DEVELOPMENT OF A METHODOLOGY TO ASSESS THE SUSTAINABILITY OF LUNAR MISSIONS.

Abstract

The Moon appears to be the next, natural step in the exploration of the Solar System. Human lunar activity will soon increase significantly: plans for an orbiting international laboratory in the Moon's vicinity, the "Gateway", are now well established together with surface exploration missions, and the coming years will seemingly experience a steadily growing traffic towards the cislunar space. Unsurprisingly, to avoid the unregulated utilisation of space and the accumulation of orbital debris, this growth should be accompanied by a proper framework to manage the end of service and disposal of the spacecraft employed. In this paper, available strategies to mitigate the accumulation of space debris in the cislunar space are characterized with respect to their technical feasibility and compliance to international regulations. Preliminary calculations in the Circular Restricted Three Body Problem are used to study the dynamical characteristics of trajectories in the Earth-Moon system. Then, a high fidelity model is employed to simulate the dynamics of spacecraft under the influence of perturbations and other bodies' gravitational pulls for long propagation times. Parallel computing capabilities are used to propagate a high number of trajectories with varying starting conditions. Final states are then analysed in search for families of disposal trajectories with similar behaviours, producing a dynamical cartography of the cislunar space. Starting from methods applied to Earth-bound orbital debris mitigation, a set of metrics and indices is defined to characterize orbits in the Earth-Moon system, to assess their sustainability with respect to the debris environment. The final scope of this research is to propose a methodology to assess the compliance of lunar missions with the available mitigation actions, depending on their operational orbits and mission constraints, and test this approach with current and planned missions.