Paper ID: 60322
oral
student

18th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Modeling and Risk Analysis (2)

Author: Mrs. Isabell Suchantke
Technische Universität Berlin, Germany, isabell.suchantke@gmail.com

Dr. Vitali Braun
IMS Space Consultancy, Germany, vitali.braun@esa.int

THE LONG-TERM EVOLUTION AND RISK ASSESSMENT OF SPACE DEBRIS IN MARS ORBITS

Abstract

The benefits of spaceflight activities made outer space become an undisputed fundamental resource for life on Earth. Therefore, the preservation of our infrastructure capabilities in space is inevitable and a common concern for space faring nations. Back in the 1960s few experts started thinking about the debris left in orbit once a mission is completed. Today, almost 60 years later, the risk space debris poses to other space missions are widely recognised and discussed. In these discussions, questions about space debris beyond Earth orbits began to arise. The human drive to explore and expand is influencing international interest in missions towards the rest of the solar system. Not only governmental actors, but private entities express their plans for the discovery of other worlds, especially in Moon and Mars. With the increasing number of spacecraft in these environments, the question of sustainability is posed. Will we face congestion problems at Moon and Mars as we do right now in Earth orbits? If so, could debris mitigation strategies such as early adopted de-orbiting solve the problem and confine the risk of space debris? In lunar environment this might be easier than in Mars orbits because of the principle of planetary protection. That is a set of requirements for the avoidance of forward and backward contamination of other celestial bodies. On other planets, this serves the non-interference of scientific investigations and exploration. It leads to spacecraft contamination specifications, which can be translated to minimum orbital lifetimes for orbiting space systems around Mars. A first investigation of its long-term effect on the artificial population around Mars showed a contradictory impact of planetary protection requirements and potential debris mitigation requirements. Based on a projected moderate future launch traffic, the number of satellites in Mars orbits increases rapidly when attempting to comply with the planetary protection requirements and not having implemented other disposal strategies including a de-orbit to the Mars moons Phobos and Deimos, for example. Therefore, this paper studies the long-term evolution of the artificial population in Mars orbits with the focus on the collision risk assessment. Widely accepted methods to compute the collision probability are implemented and compared. Object clouds are generated and propagated further. The resulting collision risk for known orbiters is computed for their expected orbital lifetime. The effects of different launch scenarios, mitigation requirements and occurring break-ups are analysed on an hypothetical basis.