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Mitigation and Standards: status, lessons learnt and future with smallsats and constellations (4)

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GEO SATELLITES END-OF-LIFE DISPOSAL – COMPLIANCE STATUS

Abstract

Space debris is a growing problem for modern spaceflight. This holds in particular for spacecraft in Low Earth Orbit (LEO) and in Geostationary Orbit (GEO). In order to control or even reduce the problem in GEO, the Inter-Agency Space Debris Coordination Committee has proposed that when at their end of life, GEO satellites should be moved to a safe graveyard orbit which is several hundreds of kilometers above the nominal GEO altitude. This rule is internationally acknowledged, and accepted by the United Nations as a guideline. This study investigates the rate of compliance to this guideline. In particular, the satellite ephemeris data provided by the US Space Surveillance Network is used to analyse the lifetime orbital behavior of all relevant objects, and to assess the state of compliance for any of the spacecraft. This is done by inspecting the semi-major axis, eccentricity, inclination and longitude position of individual satellites over the time frame from 1975 until 2016. In total, almost 1000 spacecraft have been reviewed. Although the developed algorithm with which the status of individual objects is established is open to minor flaws occasionally, it can be concluded that a statistical analysis only as function of the orbital elements of GEO satellites can be done and relevant conclusions can be drawn about their state of compliance with the mitigation regulations. The overall conclusion is that the compliance rate is considerably low for satellites launched in the late 1970s (below 40%), but that this number has been on the rise ever since and is approaching 70% for spacecraft launched in 1992. The compliance rates for later launches cannot be assessed since (a large) part of the missions is still active. However, in view of the observed trend the compliance rate can be expected to reach 100% for spacecraft that have been launched recently.