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IISL COLLOQUIUM ON THE LAW OF OUTER SPACE (E7)
UNCOPUOS and ITU Registration of Large Constellations (2)

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MANAGEMENT OF ORBITAL MANOEUVRES FOR SATELLITE CONSTELLATIONS AND COMMERCIAL SPACE ACTIVITIES

Abstract

On 2 September 2019, the European Space Agency's Aeolus Earth observation satellite was required to make an immediate axial shift — commonly known as a 'delta-V' manoeuvre — to avoid collision with SpaceX's Starlink-44 satellite, which had lowered its orbital plane for system testing. Aeolus had been on-orbit at an altitude of approximately 320 kilometres above sea level for nine months prior to Starlink-44 suddenly dropping its orbit from a higher orbital plane without prior consultation with the ESA. Although SpaceX was notified of the imminent collision risk posed by changing Starlink-44's orbit to within the same altitude of Aeolus, SpaceX refused to perform a delta-v manoeuvre to change position, thereby requiring the ESA to fire Aeolus' thrusters to change orbit to avoid collision with Starlink-44. On 3 December 2021 — two years after the Aeolus near-miss — the People's Republic of China filed a note verbale to UNOOSA, detailing two instances of performing delta-v safety manoeuvres for its crewed platform the Tiangong space station to avoid collisions with satellites. The first instance occurred on 1 July 2021 after Starlink-1095 had dropped its altitude and orbit from approximately 555km above sea level to the Tiangong's orbit of 382 kilometres thereby causing a collision risk. Tiangong was subsequently required to expend propellent to preform manoeuvres to avoid the risk of collision with Starlink-1095 which failed to adjust course. The second instance of near-miss occurred on 21 October 2021 when Starlink-2305, also within Tiangong's orbital plane, performed erratic manoeuvres that caused Tiangong to once again expend propellent to perform a delta-v safety manoeuvre, thereby creating a safe zone between the two objects. Central to the issues facing both Aeolus and Tiangong is one party having to take the burden of performing a delta-v manoeuvre to change course. Spacecraft are equipped with a finite supply of pro- pellant, thereby providing a limited amount of delta-v safety manoeuvres that can be performed before the propellant is exhausted. Where a propellent is exhausted, or near exhaustion, a spacecraft's mission profile may be severely degraded, and it may have to be de-orbited. This paper will consider the liabilities of one party having to be compelled to frequently expend propellent to avoid collision due to a second party's action, or failure to act, and propose regulatory solutions and a best-practice approach to mitigating undue propellant expenditure and improved safety in orbital planes.