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SPACE DEBRIS SYMPOSIUM (A6)
Operations in Space Debris Environment, Situational Awareness (7)

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OPERATIONAL CONSIDERATIONS OF GEO DEBRIS SYNCHRONIZATION DYNAMICS

Abstract

The motion of abandoned satellites near the geostationary (GEO) region has been extensively studied, modeled, and compared to the motion of station-kept, operational satellites, providing insights into the evolution of uncontrolled orbits at GEO. Early analytic developments focused on the family of curves represented in the ascending node versus inclination space. The evolution of orbits was examined over a decadal timeframe, leveraging the secular drift in inclination as a primary determinant of population age. Over time, further efforts were made to characterize the clumping of objects at/near GEO over intervals on the order of months to years, in particular, the longitudinal drift distribution of objects at the geopotential wells. Even more recent research scrutinized latitudinal "conga line" motion with time scales on the order of hours, showing the existence of alternating six-hour periods of increasing and decreasing debris flux relative to the equatorial plane, caused by the combination of inclination and clustering in ascending node. Lastly, investigations were undertaken to characterize apparent anomalistic behavior of GEO objects and classification of objects into related families. This paper provides a unifying summary of early "bottom-up" analytical theory with more recent "top-down" operational observations, highlighting the common linkage between these dimensions of GEO object behavior. This paper also identifies the relevance of these patterns of life tendencies for future operations at and near GEO, and discusses the long-term implications of these patterns of life for space situational awareness activities in this regime.