SPACE DEBRIS SYMPOSIUM (A6)
Modelling and Risk Analysis (2)

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SEMI-EMPIRICAL SATELLITE ANOMALIES ANALYSIS HIGHLIGHTING CONTRIBUTIONS FROM THE FENGYUN-1C EVENT

Abstract

Orbital debris that are too small to be tracked and cataloged can still disrupt the operations of space systems via collision with exposed subsystems. Analyses of spacecraft anomalies are hampered by a poor understanding of the distribution of lethal fragments on orbit and the lack of comprehensive anomaly databases. Studies done in the mid-1990s are reviewed to examine typical subsystems affected, characteristic debris-induced behaviors, and on-orbit dependencies for anomalistic behavior. These studies identified events that had a strong correlation to the lethal debris environment but definitive causation could not be proven due to the lack of data. After the fragmentation of the Fengyun-1C spacecraft in 2007, a follow-on analysis was performed on several spacecraft that operate in similar altitudes to the Fengyun-1C fragmentation. The hypothesis is that if the anomalies are caused by nontrackable, yet lethal, debris the frequency of such occurrences would increase in altitudes near the Fengyun-1C breakup. Trends in satellite anomalies in the selected space systems before 2007 and after 2007 are compared. A bias of a greater percentage of unexplained anomalies that had debris-consistent behavior was found. However, the absolute number of anomalies did not increase significantly. These observations lead to the conclusion that the space environment was indeed more hazardous from debris impacts but that anomaly identification and characterization are not high priorities. As a result, lack of program emphasis on anomaly characterization appears to hamper the ability to determine the current state of risk from the nontrackable debris environment in LEO. The importance of being able to sense the onset of the reduction of operational lifetimes of satellites in LEO from lethal debris is critical to monitoring the evolution of the debris environment.