

IAF SPACE SYSTEMS SYMPOSIUM (D1)

Lessons Learned in Space Systems: Achievements, Challenges, Best Practices, Standards. (5)

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STATISTICAL RELIABILITY ANALYSIS OF LARGE SATELLITES: A DECADE IN REVIEW

Abstract

While Small satellites capture the headlines, Medium and Large (M&L), satellites continue to foster their trail in the space industry. The 892 satellites of mass over 500 kg, launched in the last decade, confirm the enduring interest in M&L satellites. Reliability is always recognized as one of the most significant advantages of M&L satellites over small satellites. With the recent interests and advancements in small satellites, is this still valid? What is the statistical reliability of conventional satellites? Does the reliability of the conventional M&L satellites justify their exorbitant cost? This paper attempts to answer these questions and many more by investigating the reliability of M&L satellites launched in the last decade. The analysis dataset consists of 892 M&L satellites launched between January 2010 - December 2019. The dataset is subject to a non-parametric analysis using the Kaplan-Meier estimator. The obtained results are then fitted into the Weibull Parametric model to identify the reliability trends. Additionally, the reliability variations due to orbit altitude, inclination, mass and design life-time are analyzed. Then the analysis is repeated for satellites launched in the previous two decades. These datasets contain 563 M&L satellites launched between January 2000 - December 2009 and 805 M&L satellites launched between January 1990 - December 1999. Then, with these results, the variation of reliability trends over the last three decades are analyzed. Finally, the reliability trends of M&L satellites are compared against the small satellites. The results from this paper will provide a macroscopic understanding of the on-orbit reliability of Medium and Large satellites, which are particularly useful during the conceptual design phase of satellites.