

Instability of the present LEO satellite populations

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Several studies conducted during 1991-2001 demonstrated, with some assumed launch rates, the future unintended growth potential of the Earth satellite population, resulting from random, accidental collisions among resident space objects. In some low Earth orbit (LEO) altitude regimes where the number density of satellites is above a critical spatial density, the production rate of new breakup debris due to collisions would exceed the loss of objects due to orbital decay.

A new study has been conducted in the Orbital Debris Program Office at the NASA Lyndon B. Johnson Space Center, using higher fidelity models to evaluate the current debris environment. The study assumed no upper stages or spacecraft were launched after December 2004. A total of fifty Monte Carlo runs were carried out and analyzed. Each Monte Carlo run simulated the current debris environment and projected it 200 years into the future. The results indicate that the LEO debris environment has reached a point such that even if no further space launches were conducted, the Earth satellite population would remain relatively constant for only the next 50 years. Beyond that, the debris population would begin to increase noticeably, due to the production of collisional debris. Detailed analysis shows that this growth is driven by collision activities between 900 and 1000 km altitude - the region which has the highest concentration of debris currently.

In reality, the satellite population growth in LEO will undoubtedly be worse since spacecraft and their orbital stages will continue to be launched into space. Postmission disposal of vehicles (*e.g.*, limiting postmission orbital lifetimes to less than 25 years) will help, but will be insufficient to constrain the Earth satellite population. To preserve the near-Earth environment for future space activities, it might be necessary to remove existing large and massive objects from regions where high collision activities are expected.