

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

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THE NASA ROBOTIC CONJUNCTION ASSESSMENT PROCESS: OVERVIEW AND
OPERATIONAL EXPERIENCES

Abstract

Orbital debris poses a significant threat to spacecraft health and safety. Recent events such as China's anti-satellite test and the Breeze-M rocket explosion have led to an even greater awareness and concern in the satellite community. Therefore, the National Aeronautics and Space Administration (NASA) has established a Procedure for Limiting Orbital Debris that includes requirements that state that routine conjunction assessment screening shall be performed for all maneuverable spacecraft having perigees less than 2000 km or within 200 km of geosynchronous altitude. NASA's Goddard Space Flight Center (GSFC) has developed an operational collision risk assessment process to protect NASA's high-value unmanned (robotic) assets that has been in use since January 2005. This Conjunction Assessment (CA) process has three main steps: 1. The United States Strategic Command screens asset ephemeris data against the high accuracy Space Object Catalog. 2. Data is sent to GSFC where it is posted to a database and automatically processed by state-of-the-art software that performs analysis to assess the risk associated with each predicted event, and produces a data package for review by the analyst. 3. GSFC Flight Dynamics Analysis Branch personnel experienced in orbit determination and collision risk assessment further analyze each high-interest event and work with mission customers to plan any necessary risk-mitigating action.

The close approach process is utilized several times per week as part of routine satellite operations for approximately 20 spacecraft. On average, every month each LEO spacecraft in the sun-synchronous 705 km regime experiences 1.5 close approaches that are predicted to be less than 1 km in total miss distance. The number of conjunctions experienced has been slowly increasing since the Chinese anti-satellite test due to the large amount of debris present in this regime. Due to the large volume of conjunction data received, much of the routine CA operations have been automated using a Collision Assessment System (CAS) developed to enable the collection and evaluation of the data. The conjunction assessment operations concept has evolved as both theoretical and operational experience has been gained.

This paper provides an overview of the NASA robotic conjunction assessment process, including descriptions of the new tools developed to analyze close approach data and of the risk mitigation strategies employed. In addition, statistical data describing the number of conjunctions experienced are presented. The first debris avoidance maneuver by a NASA unmanned spacecraft performed by Terra in 2005 is described in detail to illustrate the process.