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OVERVIEW OF ORBITAL DEBRIS MITIGATION TECHNOLOGIES

Abstract

This paper summarizes a study identifying and characterizing technologies and concepts for space debris mitigation. The focus of the paper is international.

The study included an exhaustive open source analysis of papers and presentations from NASA, DoD, academia, and international sources; a survey of industry leaders based in the US and internationally, and; a separate survey of young space professionals through Space Generation Advisory Council, a UN-affiliated body that represents the largest network of young professionals in the industry.

The issue of space debris is ascending into prominence among US DoD policy priorities. The 2011 National Security Space Strategy highlights space debris as a major issue of the strategic space environment, in which space is "increasingly congested, contested, and competitive." The Space Strategy states the nation's strategic objectives are to "strengthen safety, stability and security in space" and "maintain and enhance the strategic national security advantages afforded to the United States by space." Mitigation of space debris aligns directly with these strategic objectives.

Space debris includes everything from discarded rocket stages in orbit as a result of routine launch activity to tool bags dropped by astronauts on the ISS. Since objects in orbit are traveling at over seven miles per second, even very small objects pose fatal threats to assets in orbit. Famously, a fleck of paint shattered a window on the space shuttle in 1983. Each launch creates more debris, and as debris accumulates the risk to space assets continues to increase. The problem has the potential for exponential growth, because collisions in space dramatically exacerbate the problem by creating substantially more debris.

The paper provides a description of all publicly available and plausible debris mitigation concepts, and information and analysis to place those concepts in context. Analyses of each of the technologies assess feasibility, the enabling technologies required to develop, the type of debris for which a technology would be effective, potential externalities, any dual-use possibilities, and political sensitivities.

In addition to technologies to remove debris from the space environment, the paper will also profile existing and proposed preventative measures. These include agreements and conventions on how many rocket fragments are allowable/acceptable per launch, and discussions of deorbit motors on upper stages.