

Observations of Small Debris from the Cosmos 1408 Anti-Satellite Test using the HUSIR and Goldstone Radars

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ABSTRACT

On 15 November 2021, Russia conducted a direct-ascent, anti-satellite (ASAT) test against its Cosmos 1408 satellite, which had been in orbit since 1982. The test produced at least 1500 fragments trackable by the U.S. Space Surveillance Network (SSN). This is a significant event because the resulting cloud has the potential to endanger the International Space Station and other satellites in low Earth orbit (LEO). For almost 30 years, the NASA Orbital Debris Program Office (ODPO) has been using the Haystack Ultrawideband Imaging Radar (HUSIR), located in Tyngsborough, Massachusetts and operated by the Massachusetts Institute of Technology's Lincoln Laboratory, to perform statistical measurements of debris in LEO too small to be tracked by the SSN, nominally down to 5.5 mm at 1000 km altitude. The ODPO also utilizes the Goldstone Orbital Debris Radar (Goldstone), located near Barstow, California and operated by the NASA Jet Propulsion Laboratory, to characterize the small debris environment in LEO down to approximately 3 mm at 1000 km altitude. To characterize the small debris component of the Cosmos 1408 ASAT test, a series of observation campaigns were conducted with the HUSIR and Goldstone radars. This paper discusses the observation planning, including beam overlap analysis required for the Goldstone's bistatic operation, using a model of the debris cloud produced using the NASA Standard Satellite Breakup Model. A description of the radars and the data processing techniques used to analyze the data are also discussed. Finally, results of the measurement campaigns including cumulative flux versus size, altitude, and inclination are presented.