

NASA's Marshall Space Flight Center Recent Studies and Technology Developments in the Area of SSA/Orbital Debris

NASA/MSFC has been investigating the various aspects of the growing orbital debris problem since early 2009. Data shows that debris ranging in size from 5 mm to 10 cm presents the greatest threat to operational spacecraft today. Therefore, MSFC has focused its efforts on small orbital debris. Using off-the-shelf analysis packages, like the ESA MASTER software, analysts at MSFC have begun to characterize the small debris environment in LEO to support several spacecraft concept studies and hardware test programs addressing the characterization, mitigation, and ultimate removal, if necessary, of small debris.

The Small Orbital Debris Active Removal (SODAR) architectural study investigated the overall effectiveness of removing small orbital debris from LEO using a low power, space-based laser. The Small Orbital Debris Detection, Acquisition, and Tracking (SODDAT) conceptual technology demonstration spacecraft was developed to address the challenges of in-situ small orbital debris environment classification including debris observability and instrument requirements for small debris observation.

Work is underway at MSFC in the areas of hardware and testing. By combining off the shelf digital video technology, telescope lenses, and advanced video image FPGA processing, MSFC is building a breadboard of a space based, passive orbital tracking camera that can detect and track faint objects (including small debris, satellites, rocket bodies, and NEOs) at ranges of tens to hundreds of kilometers and speeds in excess of 15 km/sec.

MSFC is also sponsoring the development of a one-of-a-kind Dynamic Star Field Simulator with a high resolution large monochrome display and a custom collimator capable of projecting realistic star images with simple orbital debris spots (down to star magnitude 11-12) into a passive orbital detection and tracking system with simulated real-time angular motions of the vehicle mounted sensor. The dynamic star field simulator can be expanded for multiple sensors (including advanced star trackers), real-time vehicle pointing inputs, and more complex orbital debris images. This system is also adaptable to other sensor optics, missions, and installed sensor testing.

MSFC's Flight Robotics Laboratory is investigating various test capabilities to evaluate proximity range sensors and state estimation, and to test short range sensors and capture mechanisms for capturing tumbling non-cooperative satellites.