Paper ID: 103674
interactive

23rd IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 23rd IAA SYMPOSIUM ON SPACE DEBRIS (IP)

Author: Mr. David Chaparro
EO Solutions, United States

SENTINEL: SCALABLE, REAL-TIME SATELLITE DETECTION VIA SIM-TO-REAL DATA FUSION AND DEEP LEARNING

Abstract

Low earth orbit is rapidly becoming congested with orbital debris, commercial satellite constellations, and military platforms, amplifying the risk of collisions. Modern Space Surveillance and Tracking (SST) systems require an automated satellite detection system, as growing space traffic exceeds the capacity of human driven detection. The proliferation of low-cost ground-based telescope networks increases observational coverage but introduces heterogeneous noise patterns, necessitating a data-driven solution. We introduce SENTINEL, a deep-learning based satellite detector trained via curriculum learning and designed for long-term performance and cross-telescope generalization. Our approach utilizes Sim-to-real data fusion to achieve telescope-agnostic satellite detection. Experiments on real on-sky imagery demonstrate that SENTINEL sustains 93% detection precision for 11 months and maintains an 82% detection precision on unseen telescopes, addressing longevity and generalization challenges unexplored in prior work. As a resilient, scalable detection model, SENTINEL enhances modern SST systems by enabling real-time decision making in high-stakes collision avoidance scenarios.