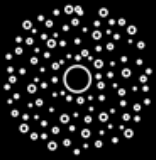# Multi-Modal Space Debris Identification and Tracking

IARPA SINTRA Proposers Day

August 10, 2022

Problem

Space systems are vulnerable to collisions with very small sizes (.1 to 10 cm) objects (debris).

Small object orbits are dynamic as they are continuously interacting with the space environment (i.e., drag) and therefore require persistent monitoring to accurately predict potential collisions.

The inability of ground-based systems to detect and track small objects suggests a space-based capability is needed.

A single sensing domain (e.g., EO, radar) is insufficient to detect all forms of debris of interest, suggesting the need for a debris detection and tracking system employing multiple capabilities.

Approach

- Utilize a multi-mode and multi-sensor combination of existing and planned ground-based and space-based Space Situational Awareness sensors to develop and test methods for extracting very low Signal-to-Noise (SNR) signatures of 0.1cm – 10cm sized Resident Space Object (RSO) in LEO, MEO and GEO orbits

- Augment with simulated NorthStar SSA constellation (2023) "always-on" 3-D sensing of small debris and simulated Hexagon US Federal Single Photon LiDAR satellite currently being studied by IC agency

- Build Multi-Modal AI-based detection library for assessment feasibility detecting objects in real time

- Determine feasibility of detecting debris-induced plasma wave signatures (e.g., solitons, whistlers, etc.) in Riverside Research Institute's plasma physics and RF laboratories

- Conduct Proof-of-Concept collection, processing and analysis using live and simulated data in the Team's Commercial Innovation Center (CIC) SecDevOps environment

- Secure SSA/STM/SDA data using blockchain combined with attribute-based access control technology
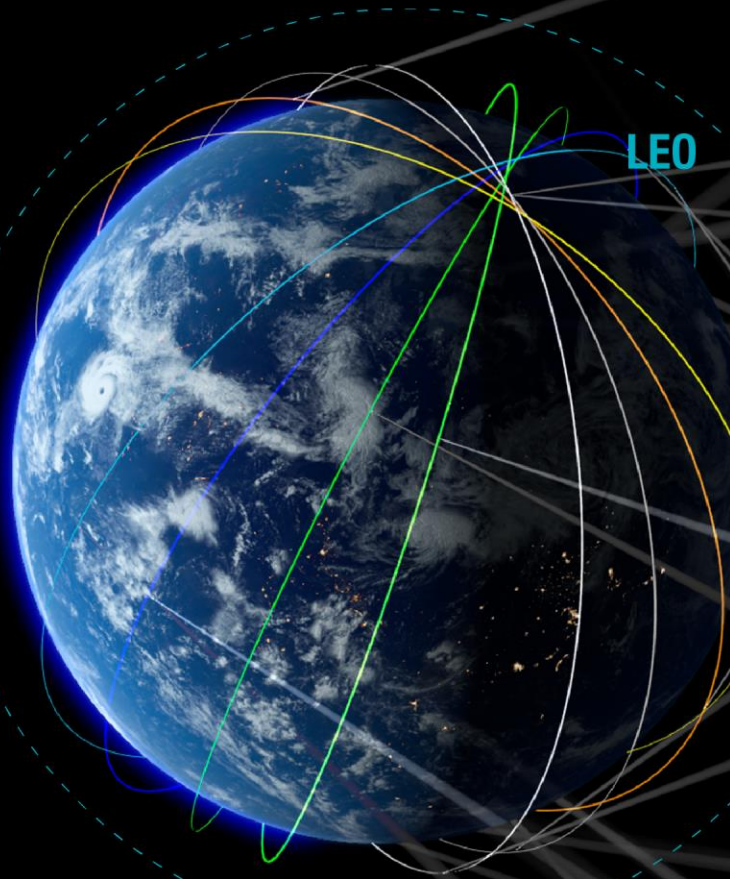
Project objective: Improve orbital object detection to 1cm through integration of sensors and signatures
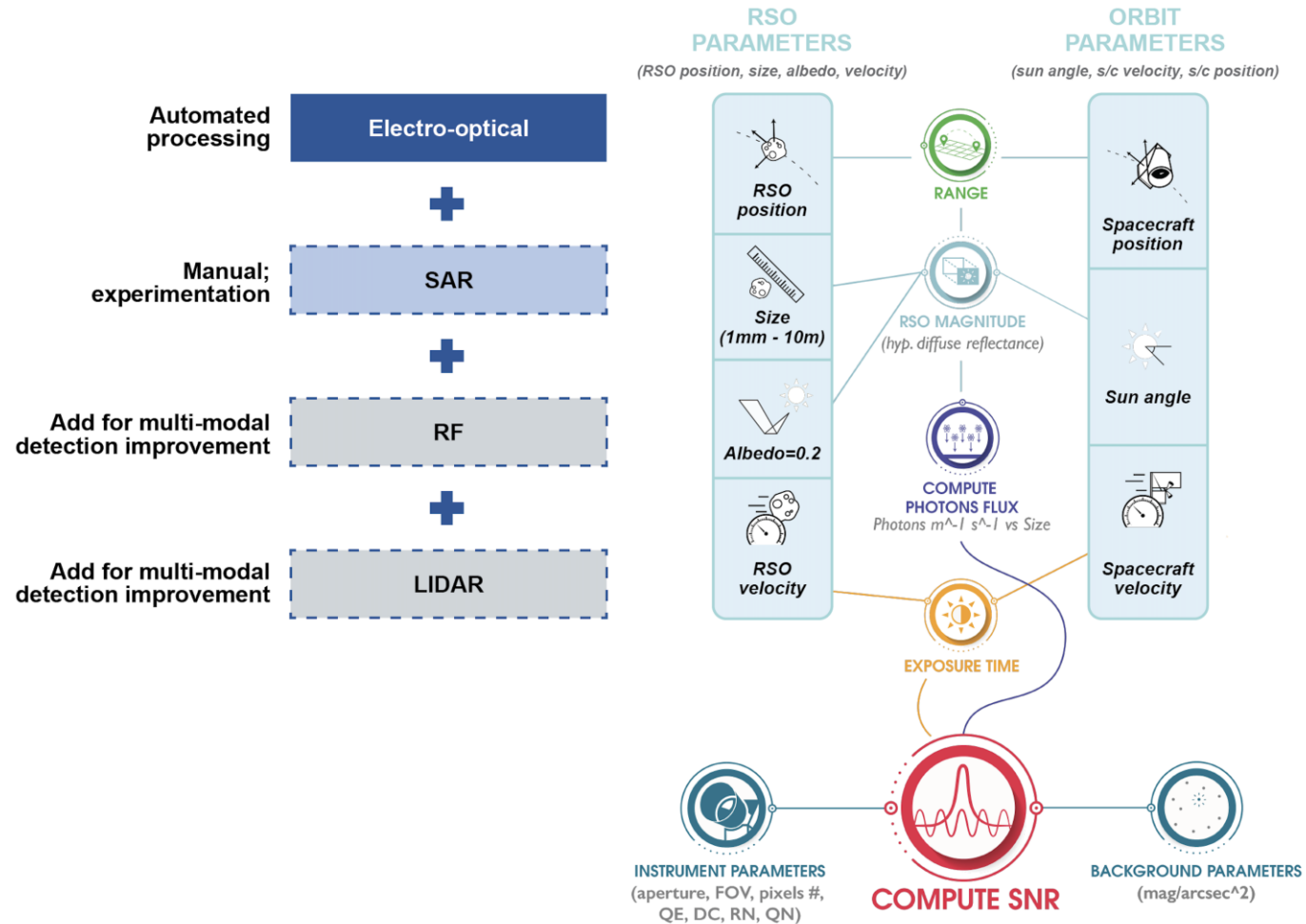
Space-based Collection, Data Integrity & Sandbox for Innovation
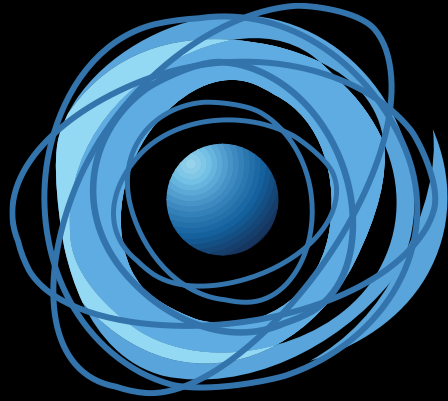

LEO

MEO

GEO CISLUNAR

Secure Data Fabric

- Attribute based access control
- Accurately/auditable data lineage
- Blockchain technology- distributed leger

Commercial Innovation Center (CIC)

Cloud Devops Interface → App Developer Interface → Data Layer
- Foundational
- Curated
- Sensor BOK
- R&D Data
→ Commercial Data Providers

Tag Data
→ Shared Services Layer
- Ingest
- Load
- Detect
- Classify
- Characterize
- Track
- Geolocate

EO, SAR, RF & LiDAR Sensor Data

CGI Confidential_22-000-075f

For more information

Denny Brisley, NorthStar US denny.brisley@northstar-data.com
Ann Carbonell, PhD, Riverside Research acarbonell@riversideresearch.org
Hudson Sutherland, CGI Federal william.sutherland@cgifederal.com
Ryan Morrison, Hexagon US Federal ryan.Morrison@hexagonusfederal.com