

IT WG1/4 Proposal: Detectable, Trackable, and Cataloguing Space Object Size

WG4

18/04/2024

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→ THE EUROPEAN SPACE AGENCY

“... rule of thumb, satellites need to have characteristic dimensions of 10 cm in each major dimension for spacecraft with perigee less than 2000 km and greater than 50 cm in each major dimension for spacecraft with perigee greater than 2000 km.”

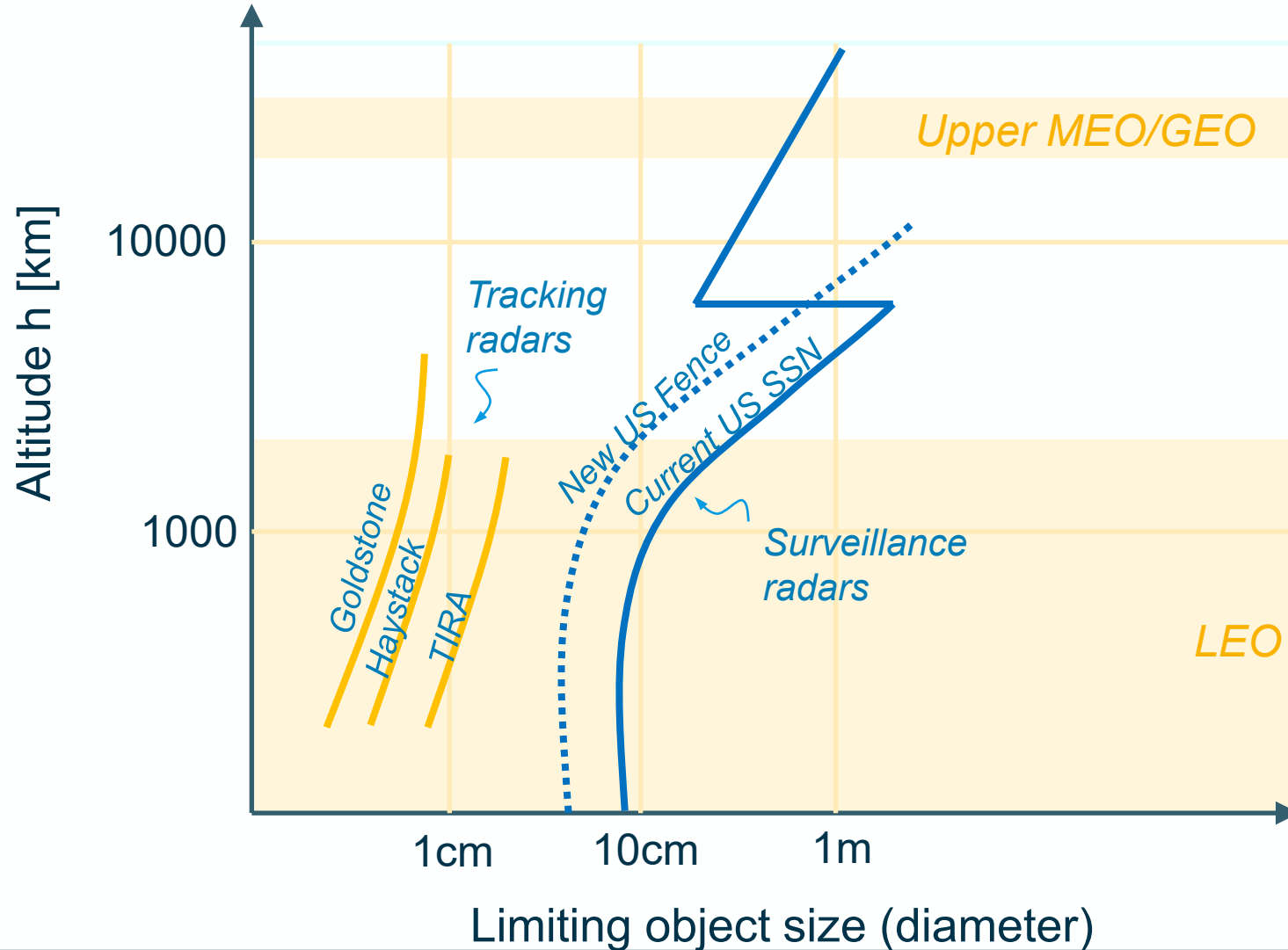
“The developer of a spacecraft or launch vehicle orbital element injected into Earth orbit shall guarantee that it can be tracked by a space surveillance segment supporting collision avoidance processes.”

“Trackability for a space object generally means having at least one dimension larger than 10 cm when the perigee is within the LEO protected region and 50 cm when the perigee is outside. An analysis taking into account the specificity of the supporting space surveillance segment can be needed, e.g. for smaller space objects or those space objects in Lagrange point orbits.”

In developing the design and mission profile of a spacecraft or orbital stage, a program or project should estimate and limit the probability of accidental collision with known objects, especially inhabitable space stations, during the spacecraft or orbital stage's orbital lifetime. If reliable orbital data and conjunction assessments are available, avoidance manoeuvres for spacecraft during all normal operations and co-ordination of launch windows for orbital stages should be considered.

Spacecraft or orbital stages, in particular those who present challenges for space surveillance networks, should enhance their trackability by adding on-board active and/or passive components to the design and consider operational procedures which facilitate use thereof.

e.g: coarse overview from 2000's



Modified from Krag (2003), Flury
et al. (2000),
Anonymous (1999b)

Surrogate network

- Simulate observations for debris population assuming network of proxy sensors with single detection curve
- Perform consider covariance analysis
- Assess trackability with threshold on estimated covariances

Trackability curve

- Describe trackability with single detection curve (e.g. simplified radar equation)

Lookup table / thresholds

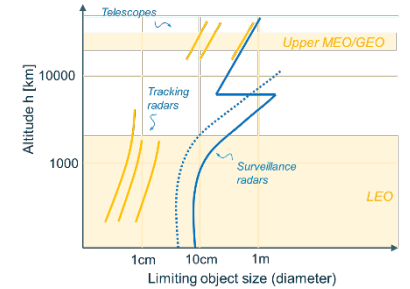
- Describe trackability with thresholds, e.g.
 - Single threshold, e.g. 10 cm up to 1000 km altitude
 - Lookup-table depending on altitude and eccentricity bin

Define a practical size criteria as function of orbital regime to determine which space (debris) objects can be assumed to be well tracked enough for collision avoidance purposes.

Output:

A single summary table or graphic, suitable for an internal report or the IADC Guide-lines support document, providing the detectable, trackable, and cataloguing sizes for space debris commonly achievable today.

Session 3.3 – joint session WG1/WG4



- Proposed shared IT on **Detectable, Trackable, and Cataloguing Space Object Size**
 - *The objective is to understand surveillance and processing capabilities underlying common and best practices for collision avoidance, not the state of the art or future evolutions. It is explicitly not within scope to analyse, retro-engineer, or infer the performance characteristics of operational space networks or contributing sensors thereof.*
 - The WG1 raised concerns in a preparatory call, and clarification received from WG4: the objective is to understand what systems can deliver for collision avoidance needs.
 - No need to disclose sensor design, architecture, etc., rather to define together metrics for confidence numbers and planned evolution of systems from accessible sources (such as also the commercialisation activities).
 - WG1 would appreciate details on the text of the related draft guideline and underlying objective
 - WG1 is unable to advise on “cataloguing size limits”, but can advise on RCS and magnitude limits for **detectable** and **trackable** objects (subject to agree on definitions) for current state-of-the-art and future
 - WG1 needs to refer to size estimation models to derive diameter limits → WG2
 - WG1 needs to refer to collision consequences models → WG2/3
 - WG1 has insufficient insight into cataloguing processes, related uncertainties, accuracy, completeness, and timeliness information
- WG1 is ready to revise the IT description accordingly, and to discuss the implementation process

Inter–Agency Space Debris Coordination Committee



Meeting

22/04/2024